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A DESIGN FOR A SELF-ACTING FOUNTAIN.

BY C. MAYNARD WALKER.

UNTIL perpetual motion becomes an accomplished fact, the term self-acting must always be one of convenience rather than accuracy, as, strictly speaking, there is no such thing known as a self-contained force. An ordinary clock appears to be self-acting, but, as every one knows, it comes to a dead stop so soon as the force which was put into it by the act of winding up the spring or weight becomes exhausted; and, in like manner, any other piece of self-acting machinery must, of necessity, be under the same law. So that what are known as self-acting fountains are contrivances for forcing up a jet of water to any required height by the exercise of a reserved power, and are distinguished from ordinary fountains in that they are portable and do not require to be connected to any water supply or waste overflow. They are thus very interesting, and convenient for decorative purposes where it would be difficult and inconvenient to run a water service. I have been careful thus to clear the way in the foregoing remarks in order that the reader, who may be a novice in hydrostatics, may be deterred from expecting too much; for I frequently find that no sooner does an ingenious sort of man, not fully informed on this subject, get hold of the idea of a self-acting fountain, than he straightway wastes a good deal of time in a vain endeavour to make it go on for ever. I think perhaps it is the absence of any wheels, weights, etc., in the apparatus which makes it appear that the water rises up of its own accord, and with a little further improvement might be made to keep itself going. Believe me, the whole thing is on just as hard and fast lines as any other piece of mechanical work, and after using up the power you put into it, will come to a stop. There are numerous methods of making the water rise in these portable fountains — some with plungers, some by the gradual fall of a heavy weight on a flexible reservoir, some by a spring, others by air bellows, etc.; but, undoubtedly, the simplest and most effective method of all is that which is known as Hero's

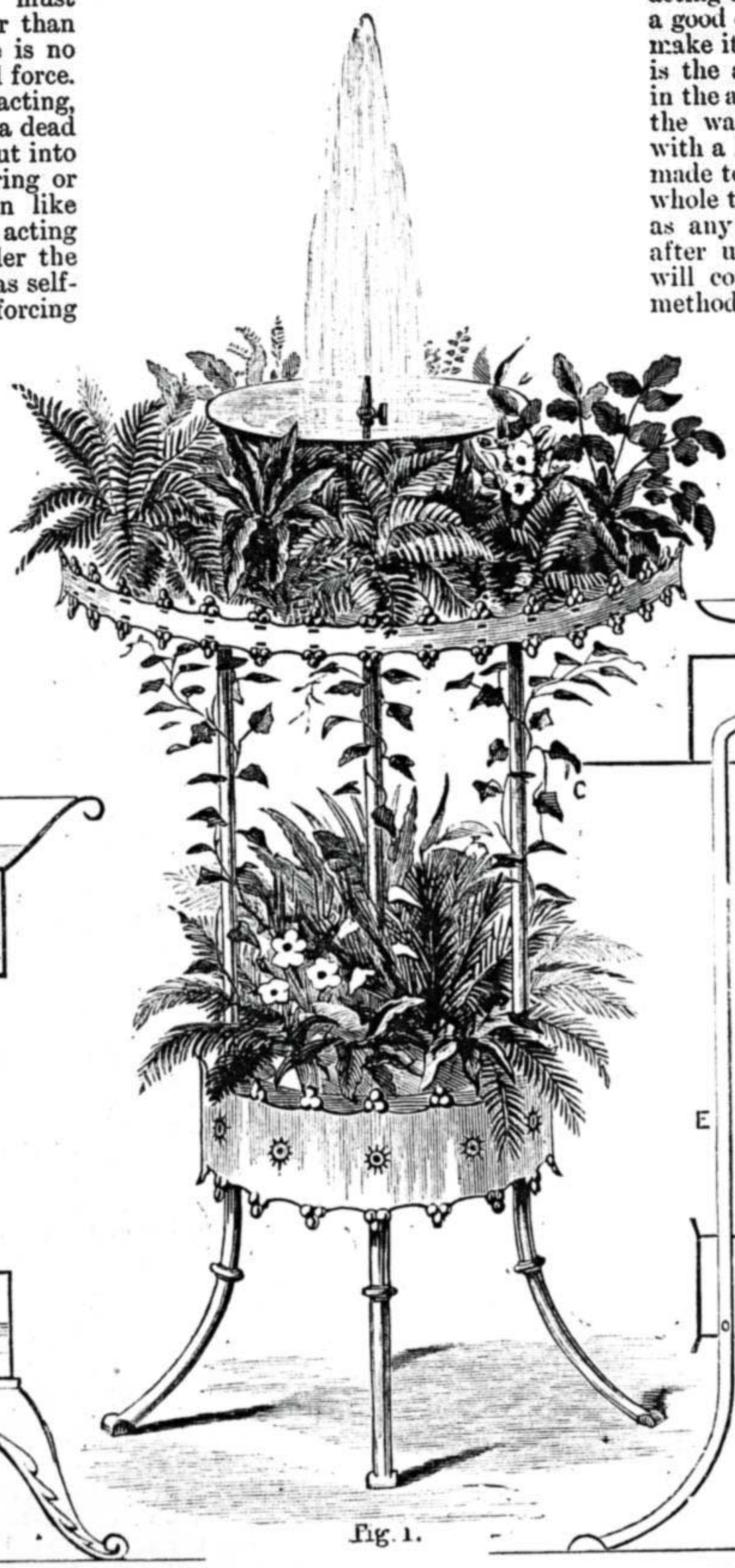

Fig. 1.

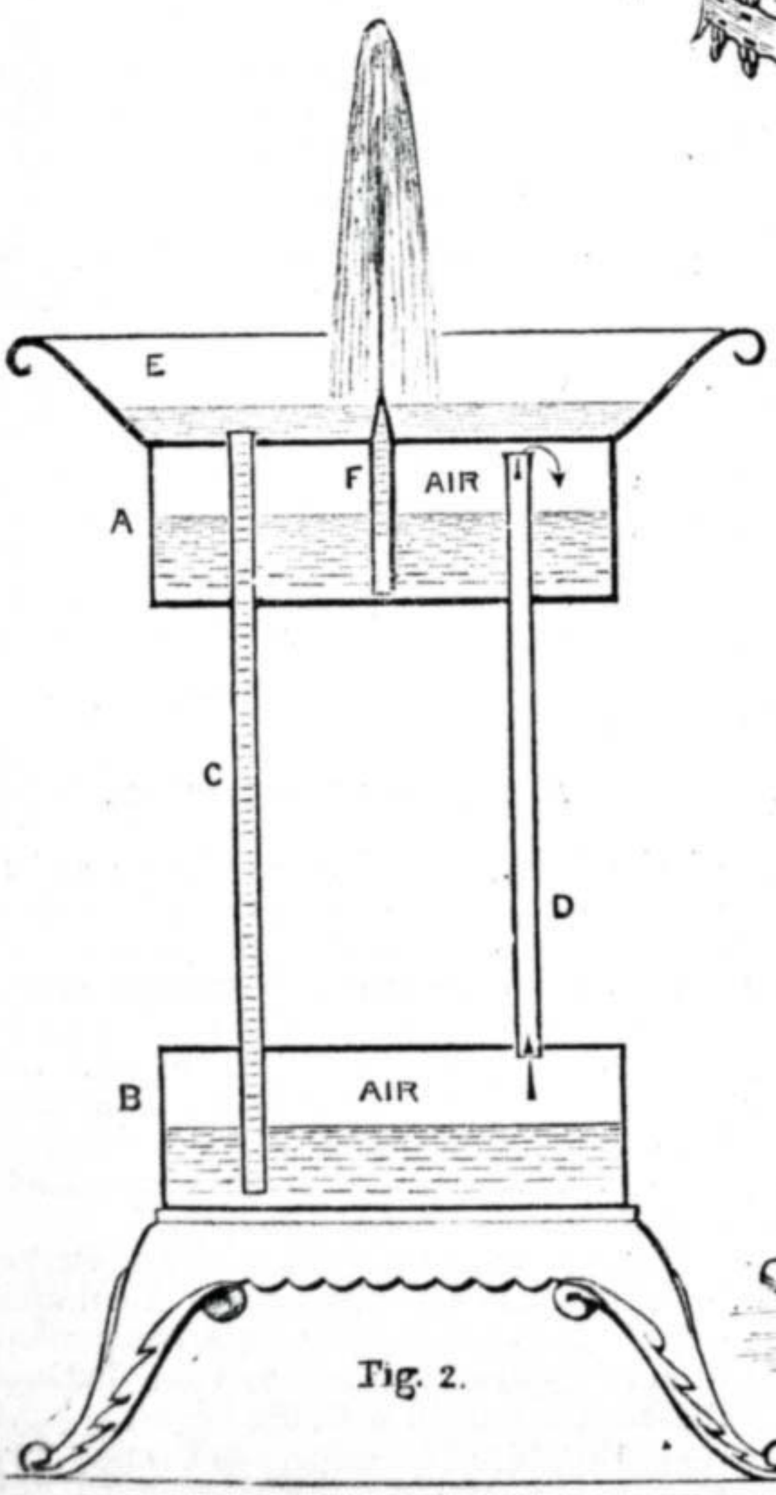

Fig. 2.

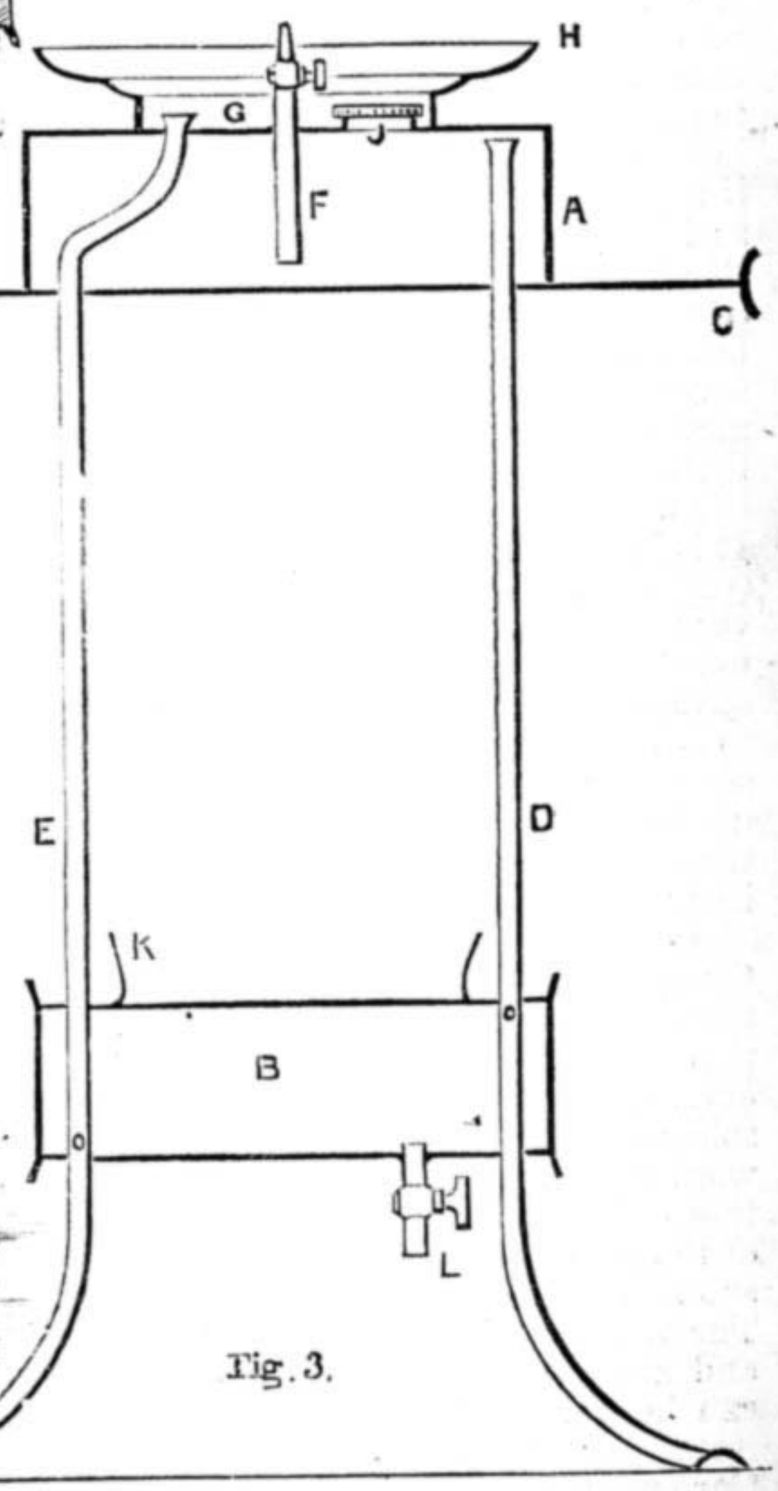

Fig. 3.

Fig. 1.—Design for Ornamental Self-Acting Fountain Table, complete and furnished with Plants. Fig. 2.—Diagram showing Construction and Working of Hero's Fountain. Fig. 3.—Section of Fountain Table showing Method of Construction.

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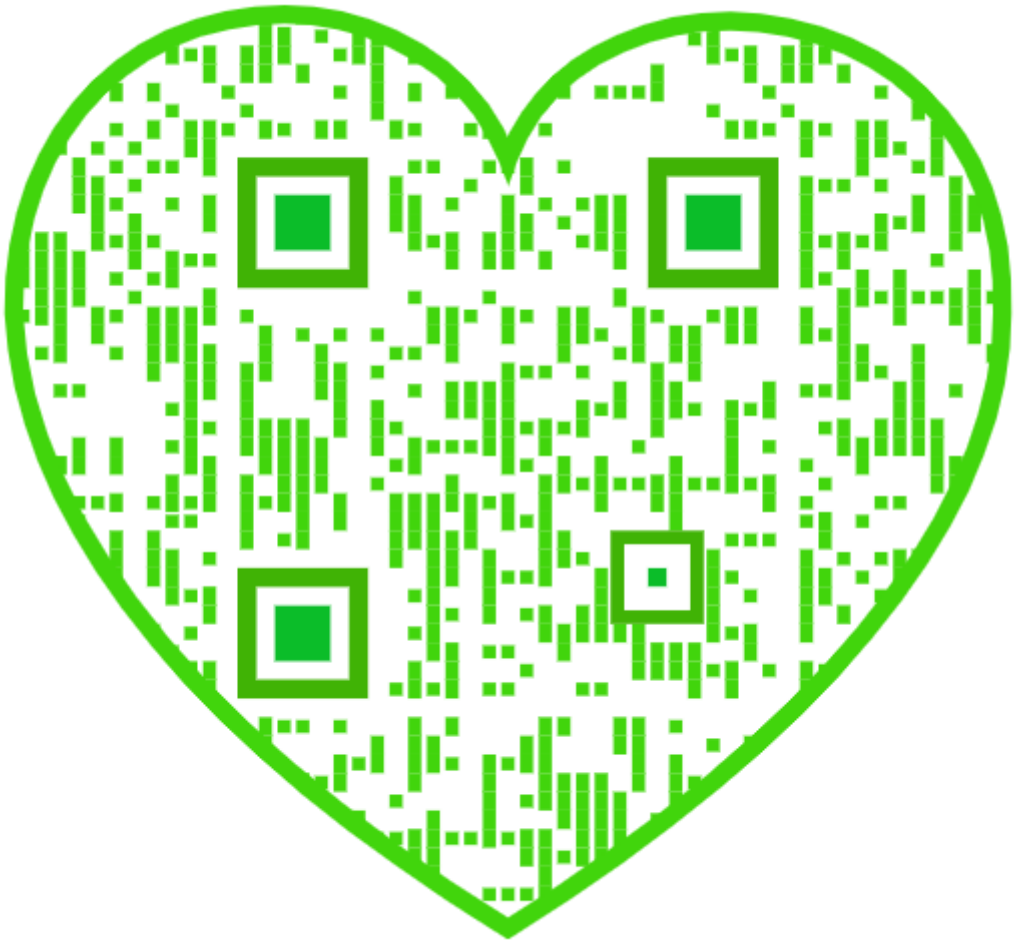


fountain, which contains no weights, wheels, springs, or any movable parts, and yet works with unerring accuracy so long as the vessels remain sound. This principle is called hydro-pneumatic—the action of water and air. The principle admits of an indefinite number of forms and arrangements in the exterior, of which Fig. 1 is one; and may be made in any dimensions. This kind of fountain is interesting, moreover, from the fact that it is one of the oldest contrivances in existence, and is known to have existed two thousand years ago, being described in the "Spiritalia" of Hero, who lived some fifty to one hundred years before the Christian era; and, however much the exterior may have changed phases since, the ingenuity of mechanical men has been unable, through all those centuries, to make any improvement in its construction which will render it more effective. Fig. 2 is a diagram illustrative of Hero's arrangement. It consists of two vessels, A and B, air and watertight, except at their openings, which communicate with each other by pipes, having a lip, or basin, on the upper edge of A. If water is poured into E, it will run down the pipe C, filling B, the air escaping up D, and out at the jet-pipe F. The water will continue to run until the pipe D becomes full, and the bottom of A covered with water sufficiently high to cover the mouth of the jet-pipe. No more will, however, run in then, as the air is no longer displaced. Now, if the fountain be turned upside down, the contents of B will run through D and fill A, the air escaping through the jet pipe. If, now, the fountain is set upright, we have A full of water and B full of air. If water is then poured into the basin, it will, as before, run down C, but the air can no longer get out at the jet-pipe, because the latter is immersed, so that the air in B becomes compressed by the hydraulic force of the water of the pipe C, and as this compressed air passes up D into the upper part of A without loss of force, it follows that the water of A is under the same pressure as B, but as it is so many inches higher up than B, the water of A will, if released at the jet-pipe, endeavour to flow as high as the length of the pipe C, minus its dip, and will continue to do so as long as any compressed air is left to force it up, but not a moment longer. The process of reversing the apparatus—or some other method of getting the water out of B and lifted up into A—must now be performed if the work of the fountain is to be repeated. It is just this power which has to be exerted (varying in proportion as the dimensions vary) which stands between our self-acting fountain and perpetual motion. The object of the design at the head of this article is to cover the bald arrangement of Hero, with some attempt at ornamentation as well as usefulness; and to so arrange the periodical recharging of the upper vessel as to reduce its inconvenience to a minimum.

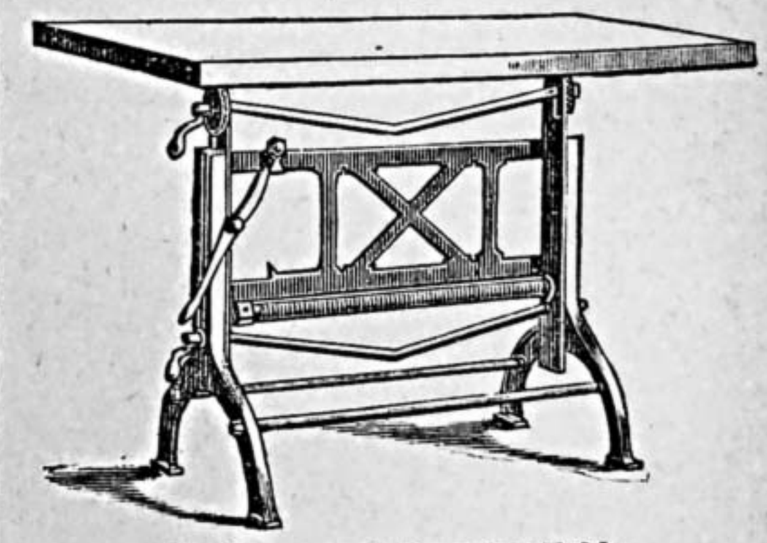
Any one who can solder may undertake the making up of this fountain with a certainty of success; and as the ornamental portion is bought ready made, and really covers the work, even a little clumsiness of soldering will be out of sight; but the worker should, before setting to work, thoroughly read and understand the working of the fountain—the rest is very easy. Fig. 3 shows in section the arrangement of parts. The vessels are made of No. 10 sheet zinc, and are ornamented with zinc fret, which can be obtained from Messrs. Still & Co., metal spinners, Charles Street, Hatton Garden, E.C. The legs consist of lengths of brass tube, four in number, arranged as shown (Fig. 3). The question of measurements is one which must be left entirely to individual taste. I may mention, however, that I found a very convenient size measured—height over all, 3 ft.; width of fern tray (C C), 18 in. (inside); water vessels (A and B), each 12 in. diameter × 3½ in. deep; legs of ¾ in. brass tube; water well, or basin (G), 8 in. diameter × 1½ in. deep; glass centre-dish (H), 11 in. or 12 in. diameter. It will be seen that very great inconvenience would arise if it were necessary to invert this fountain each time it stopped playing, to obviate which a draw off tap L is used, in conjunction with an *air-tight* screw filling-plug J. With above sizes, the fountain will throw up a pretty jet to a height of about 20 in. for about one hour at each operation, the process of recharging occupying about one minute, the same water being used over again.

To make up such an one, the worker will require to cut out a circle of zinc 18¼ in. diameter, and three circles of 11¾ in. diameter. These should be turned up at the edges all round for ⅛ of an inch. If not experienced at this, send the sheets to the tinman to be jennied, costing a few pence only. For the ornament round edge of fern tray, use No. 240 fret (Still's Catalogue), soldered on securely all round, and *watertight*, or a disagreeable mess is made when watering the plants. I have used the same fret for B, but with the stamping upon a wider margin; but as this is difficult to procure in small quantities, the maker of one or two fountains must be content to use an edging of narrow fret top and bottom of B, making up the complete cylinder in sheet metal first. The brass legs are carried right through the lower vessel and under side of top. Great care must be taken that the holes for these are true with each other. These are made with a ¾ centre-bit. Having settled these, it is best to solder to each leg (at the point where the bottom of vessel will be soldered) a small piece of metal, so as to prevent the vessel going too far on, and to hold up the work until it can be tacked together. The novice will find the four legs somewhat "wobbly" as he endeavours to make them stand upright. To get over this, prepare a piece of board, and sink four holes to correspond with the size and position of those in the zinc; pass the leg through B, and put over their upper ends the piece of wood, the sunken holes of which will hold the legs tight and true until you get the lower part soldered up. Notice (Fig. 3) that a hole must be made in the pipe D at the point indicated, also a hole in the pipe E just above the bottom of vessel. The other two legs are dummy pipes. All the legs must be stopped up by soldering at bottom. The pipe D reaches to not quite the top of A, to allow an air vent. The upper curved end of E is employed to bring it inside the basin G. If the worker can manage it in one piece the better, but if not, a bit of ½ in. compo. tubing may be joined on. A length of ⅜ in. compo. will do for the jet-pipe, and a convenient jet is formed by using what is termed among gas-fitters a cigar-light cock, to be had through a dealer in gas-fittings. The glass dish can be obtained at the same source, termed a "glass consumer," with about a 1 in. hole in the centre, cost about 1s. 6d. retail. This rests loosely upon G. For the filling-plug J use a "lamp feed screw," with a soft and effective washer. The bareness of the legs is taken off by festooning them with artificial ivy cut from zinc, and fastened with wire stems on to wire about ⅛ in. thick run spirally round each leg. The cutting of these leaves is quite easy with a strong pair of scissors, and look effective when painted a natural tint. The tray K is formed by soldering on a ring of zinc about 1½ in. deep, and affords a handy receptacle for small ferns and lycopodium. Before attempting any painting, the work must be thoroughly tested, as the slightest leak will be fatal to its working. Having settled this matter satisfactorily, we will give the fountain a complete trial, thus—take off the screw-plug and pour in water until the top vessel becomes full, replace plug, and at the tap L draw off any superfluous water there may be, turn off the tap, and nearly fill the basin G, when the water will instantly rise from the jet, and continue playing until exhausted. Then draw off at L, and refill as before. Paint the work to your taste, and plant ferns, etc., all round space outside top vessel and centre of legs. Your zinc work will last much longer if the inside surface before soldering up is painted over with Brunswick black; and, in conclusion, permit me to add that I will gladly answer any inquiries on points that may not be quite clear in the columns of "Shop."

AN IMPROVED DRAWING-TABLE.

BY JOHN CHARLES KING.

FEWER tasks in a draughtsman's office demand such intense application of mind to ensure accuracy as in the scale drawings of machinery intended to serve for the exact guidance of pattern-makers, model-makers, and constructive machinists. With the most perfect instruments and best paper, good light, and office secure from jar and interruption, there is still need of a desk or table adjustable so that the strain on the human frame shall not be intensified by having to reach over to the top of the drawing-board with instruments held or moved on the paper often beyond the easy stretch of vision with its dual watchfulness



An Improved Drawing-Table.

of the instrumental manipulation and the critical resultant effect on the paper, shown sometimes to the hundredth part of an inch.

How few tables fulfil the requirements of the worker in aiding him and saving him from constrained physical effort: more brain-wearing and nerve-exacting to ensure the exactitude of an almost infinitesimal point in a drawing than would be the vigorous use of a sledge-hammer at the forge.

This has long been felt as one of the neglected matters in the appliances of a drafting office. Many makeshift contrivances have been adopted from time to time, but even these are attended with the irksome feeling that they are unstable, and may move slightly at a critical moment of work. From

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Cincinnati, U.S., a drawing-table has been introduced to draughtsmen, which fulfils most of the urgent requirements for an adjustable table, with perfect immovability during work, and admitting ready alteration to any height or angle of surface of drawing-board.

On the centre line of the under side of the table are two vertical iron sliding pieces fitting to the uprights of the standing frame; a horizontal shaft is shown at the bottom of the sliding frame, which has racks engaging with wheels on the ends of the horizontal shaft. A spiral spring is shown wound round this shaft, its purpose being to serve to balance the weight of the movable part of the frame and table-top; this secures the board from sinking if left at any elevation without clamping securely.

The raising or lowering of the frame is effected by a hand lever, having its fulcrum on the standing frame.

Two pieces of bent tubular iron are shown with bolts through their lengths, with clamp handles for screw tightening at one end of each. The ends of these pieces of bent tube simply butt against the sides of the upright sliding pieces.

The action of turning the clamp handles is to straighten the tubes by the internal bolts, pressure making them grip the uprights firmly, while the grip of the bolt-head and clamp holds the upright at any height, or the table-top at any required angle of inclination.

Simplicity and ingenuity combined ensure an economical instrument in light malleable and wrought iron, ready for fixing the drawing-board in its place.

They are named the "I. X. L. Drawing-tables," and are made by Jones and Mack, 5, West Fourth Street, Cincinnati, U.S.A.

PRACTICAL DETAILS OF BOOKBINDING.

BY GILBERT CLARKSON.

BOOK SEWING BY MACHINERY—END OR WASTE PAPERS—CASE MAKING.

BOOK SEWING can now be done by machinery. There are a few different kinds of machines made by different makers for this purpose; but *the* machine is that one known in the trade as the "Smyth Book-sewing Machine" (Fig. 15). It is, considering it as a machine, a most wonderful invention. Its movements seem so full of intelligence—so human-like that one can almost fancy it must have a brain concealed somewhere to regulate and govern them.

If I tried to describe it I would fail, for words of mine could not give it justice. I can only quote from the catalogue lying before me, and as I have had a long personal experience with it, I can endorse all that is there said about its capabilities.

"This is an entirely new and original machine, for sewing together the sheets or signatures of a book. The work it produces is more solid and much stronger than that produced by hand, and it can sew a book however thick, from a demy 4to to a royal 32mo.

"On a comparison of results, the hand method produces in a liberal average 2,500 signatures sewed per day. With this machine 15,000 to 20,000 signatures can be sewn per day, leaving a margin of 13,000 signatures to balance investment and running expenses. It sews without tapes, or with one, two, three, or four tapes."

The above quotation is from the report of the judges (who were leading bookbinders) at the exhibition where it was first exhibited, and where it gained for its inventor the Grand Gold Medal of Honour of the American Institute.

There are four radial arms on the machine which project from a vertical rod; on these arms the sheets are placed one at a time. The arms rotate, rise, and adjust the signature, so as to bring it to its proper position under the curved needles.

As each arm rises, small holes are punched, by means of punches, in the sheet from the inside to facilitate the entrance and egress of the needles.

The loopers then receive a lateral movement to tighten the thread, and this movement is made adjustable in order that books may be sewn tight or loose as required.

It has become very popular in this country. There are hundreds of these machines now in use—some shops running as many as twelve and fourteen. Just fancy the number of books that will be sewn with twelve of these machines in a day!

Oh, shades of Caxton and Wynkyn de Worde; oh, Roger Payne and Clovis Eve, rest in your graves! Come not back to visit us now! We would frighten you, we would bewilder you with our thousands and tens of thousands of volumes folded, sewn, and bound in a single day.

The careful workman when he gets the books from the sewer will take up each volume separately and knock it up to the back on his lying press, and then grasp it tightly by the fore-edge, and tap it gently along the side of the back with the hammer to lay down any unnecessary swelling. This may not seem a very important matter, but I like to see a man beginning the process of forwarding in this manner. Before putting on the end papers, or, as they are sometimes called, the waste papers, the first and last leaf of the book should be pasted down. Throw back the last leaf and paste the second last leaf neatly about ⅛ in. from the back, and turn over the last leaf again to its place and rub it down with the finger; treat the first leaf in the same manner.

The waste papers may be white or coloured, enamelled or marbled. They may have cloth or leather joints. For plain, half-bound books, a good white waste paper looks best. About 20 lb. printing demy is the very thing for 8vo magazines. It is even heavy enough for quartos. If the joint of the book is well made, there will be no fear of the paper splitting. For each book double waste papers or four fly leaves will be required. They are put to the book in the following manner:—The paper is first cut a trifle larger than the book, then folded, and spread out on the board or table, the fold to the right hand, each sheet set back about ¼ in. from the other and pasted. Each sheet will have thus a line of paste down the back ¼ in. broad. Lay the book on the bench with the fore-edge toward you, lift a sheet of paper and lay it carefully on the book flush with the head, and the fold flush with the back, draw the heel of the hand down it to give it a set; open the sheet, and in the inside paste another in the same manner, taking care to have the fold of the paper again even with the back of the book. I do not like the fashion of pasting the waste paper solid, *i.e.*, pasting the first two leaves together, it makes the joint far too hard, and instead of making it stronger as the intention is, it makes it more liable to break, and besides, gives the book a very uncouth appearance. Marble papers should be treated in much the same manner. Put on the white as directed above, and paste one half of the marble paper—that part which is to come nearest the book; rub it well down with the hand.

These remarks only apply to ordinary jobbing. When there are thousands of volumes to waste paper, we have to consider what is the most expeditious method and act accordingly. But, at the same time, we must not sacrifice neatness and cleanliness for mere speed. A cheap book may be a neat book; at the least, it can be clean.

Before leaving this part of the subject, I want to give a nice wee wrinkle to those whom it may concern about cloth joints. There is wanted for a pair of marble or coloured papers with cloth joints the following:—Two fly leaves of white paper, two strips of cloth and four pieces of marble or coloured paper, and, of course, the glue-pot and brush. Fold the cloth lengthwise, and instead of gluing it all over, glue only one half. Lay the white sheet with the fold along the glued portion of the cloth, turn it over, and fold it again. The cloth will now be in the inside, half of it sticking to the paper and the other half loose. Glue the coloured paper all over, and lay it to the edge of the cloth and rub it down in the usual manner. There will now be a loose bit of white paper along one side; when putting the waste papers to the book, this should be kept to the outside, and when the book is bound and comes to be pasted up this loose piece will have to be cleaned off the result will be a cloth joint that will no need much persuasion to make it stick to the board, and the book will close ever so much nicer.

I trust I have made this plain. I know it will be like the news that was brought by the fiddler to some binders. I learned it long ago when Family Bibles were more fashionable than they are now.

When books are waste papered, they are next glued up. To do this, knock them well up at the back so as to get them square. Glue them with good thin glue. Rub it well in between the sections and leave them to dry.

While they are drying, I will draw your attention to some remarks about case making, *i.e.*, making cases for cloth-bound books.

This method is resorted to in these days for the sake of speed.

We have to bind books not only cheaply but quickly. So when we have a few thousand volumes, instead of going round the old-fashioned way of fitting the boards to the book after it has been cut and covering it with cloth or leather, we cut the boards all one size and make the cases many a time before the books are printed.

Case making is a very simple matter, and is generally entrusted to girls. Very little explanation is necessary. The whole secret lies in getting the boards square to begin with.

The boards may be cut with the guillotine or the Rotary Mill-board Machine (Fig. 16), nick-named the dulcimer. The last named is a very useful machine when the boards are thick and we want to save the guillotine knife. But, for most work, resort will be made to the guillotine.

This machine is too well known to require description here. To tell a binder about a guillotine would be as useless an undertaking as carrying coals to a well-known coaling district. Still, all guillotines are not alike, and some deserve special mention. I am thinking now of one of Messrs. Furnival & Co.'s "Self-Clamp

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Machines" (Fig. 17). What a powerful machine it is! and what an amount of work it can accomplish. A touch of the finger is all that is wanted to start it at full speed, when it will clamp, cut the job, and return in two or three seconds. There is practically no limit to its capabilities. As fast as the cutter-man can manipulate the stuff it will cut. It can be stopped instantly at any part of its ascent or descent. Where steam power is available, these self-clamp machines are a great boon.

While on the subject of cutting machines, I may mention something quite new in this line—something not generally known—a machine which is sure to find its way into every binding shop which has a right to the name. It is called the "Ever-sharp Quadruple Cutter." It is specially adapted and intended for trimming the edges of printed books, pamphlets, and stationery. The machine in a less complete form has been long known in the United States, where about 800 are at work.

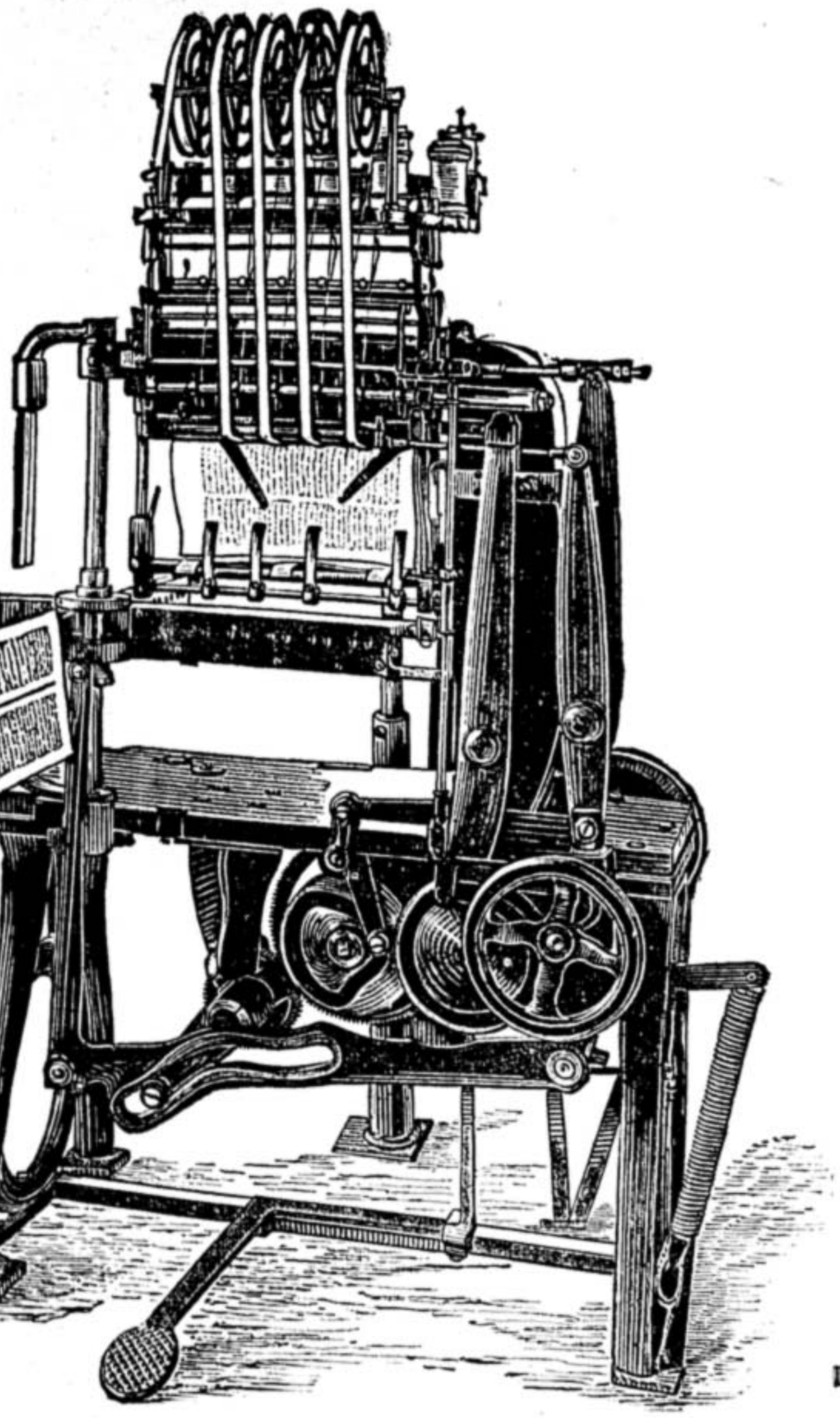


Fig. 15.—Smyth Book-Sewing Machine.

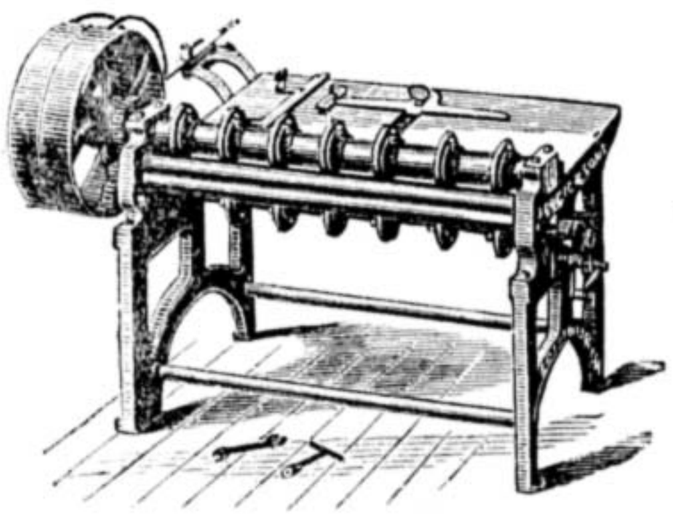


Fig. 16.—Rotary Mill-Board Machine.

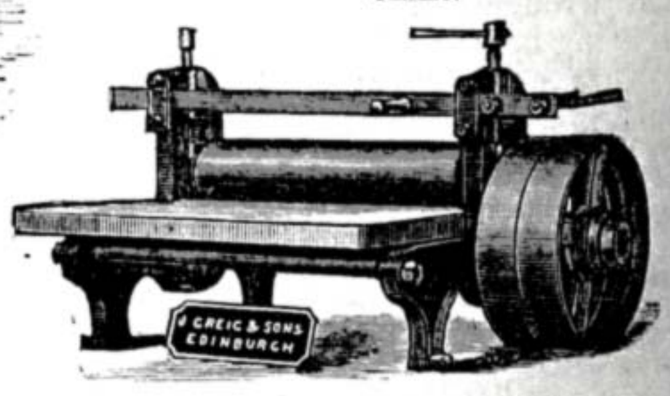
It will be an important adjunct to the ordinary guillotine in large binding and printing establishments. It has been little known in this country, although it was introduced into one large establishment in Scotland some years ago, where it cut so clean that it was proposed to reduce the cost price paid to the binders for gilt edges because no scraping was needed. An objection was made to it because the knife required sharpening oftener than the ordinary guillotine, but the quantity of work done was not taken into consideration, and these and other objections prevented its general introduction.

Several improvements have been made, including an apparatus for keeping the knife continually sharp, and all objections to it in its primitive form have been overcome, and it is now finding its way into the large printing and binding establishments in London and the provinces, and also, I understand, in our Australian colonies.

The latest addition to it—the patent sharpener—has just been made by Mr. W. C. Horne, who is the English maker of it.

The machine is in most respects very unlike the well-known guillotine. The knife is stationary, and the work moves to it just the reverse of the usual operation of paper cutting. The work is placed on a solid iron bed, in the centre of which for small work runs the clamping screw, and against the square sides of which the backs of two sets of books are placed. The gauge for the cutting is a wooden platen, exactly the size of the book to be cut, and when the work is placed in order and screwed down, the table is slidden towards the knife until the wooden gauge touches it; and then, on pressing a treadle, the table rises up an incline of 45 degrees, the knife cutting the work as it rises in a rapid and clean manner.

Fig. 18.—Greig's Case-Rolling Machine.



As soon as the cut is made an automatic action returns the table to its starting point, and then the workman turns the work round for the next cut, the same operations being repeated until four sides are cut. The blocks for the various sizes of work can be placed in position in a few seconds. Work, according to its character, to 8 in. thick, can be trimmed in one cut, and it will cut from 4 in. × 2½ in. up to 12 in. × 16 in. From the rapidity of its movements it has received the name of the "Demon."

It is not intended for sheet work, but it is a valuable addition to the cutting power of an establishment. Let

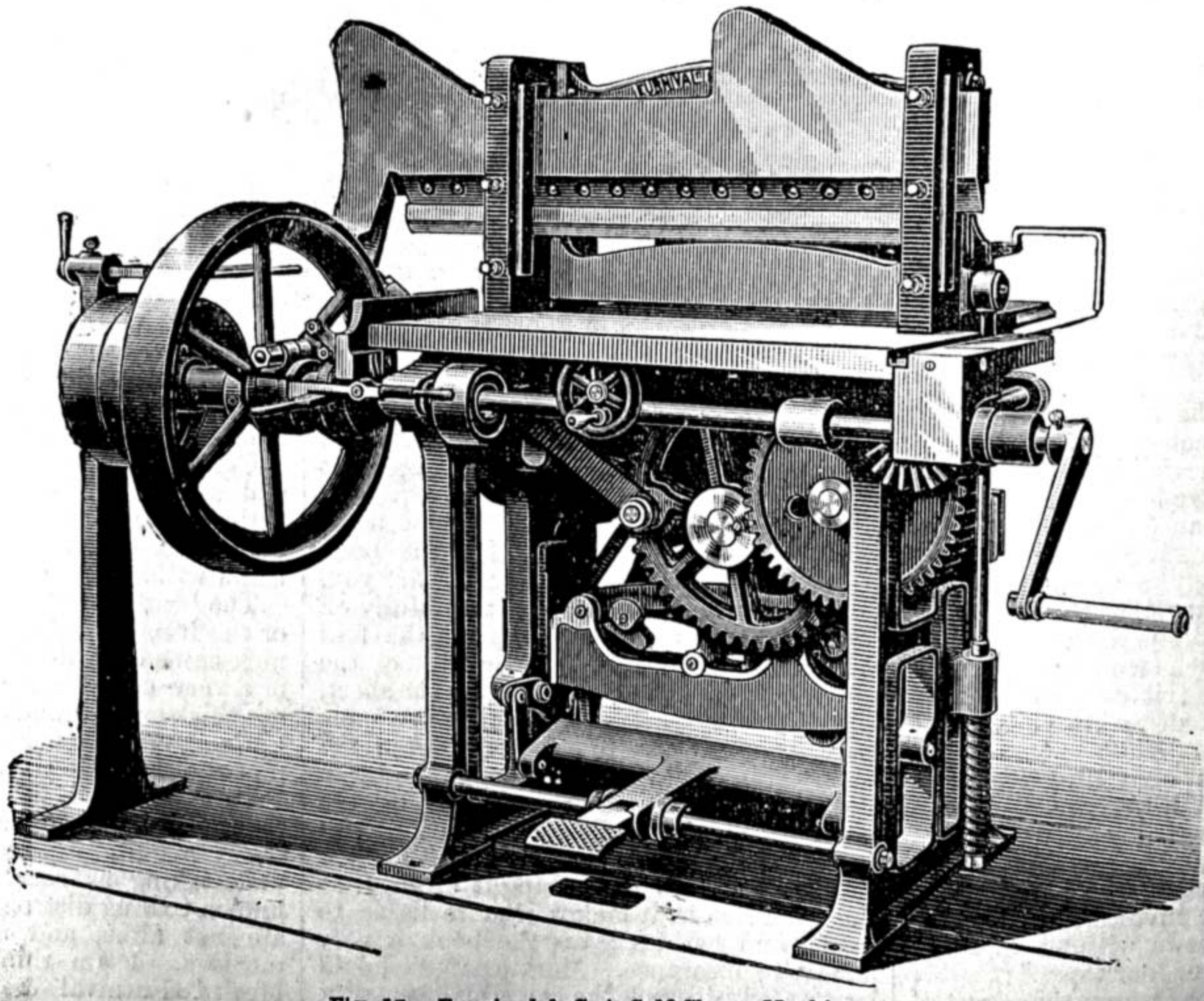


Fig. 17.—Furnival & Co.'s Self-Clamp Machine.

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us hope * that it will be the means of causing publishers to trim their periodicals before sending them out, and so do away with that ever *blunt* paper-knife, the fore-finger.

But to return to case making. The usual method of making cases after the boards and cloths have been cut is to glue a cloth and lay it flat on the table; give it a look over to see if the gluer has left the hairs of the brush on it. If there happens to be one pick it off, for a hair shows very badly, especially on satin-grained cloth. Lay a board to the left-hand side, put the back gauge close up to it, and put the other board close up to the gauge. Turn all over and give a sharp rub with the hand, cut the corners with a pair of scissors and turn it in, rub down with the folder, and repeat *ad libitum*.

Messrs. Greig and Sons, Edinburgh, make a case-rolling machine (Fig. 18) which is a very serviceable machine in cloth-binding shops.

When the cloth is turned in, the case is simply passed through the machine. The rollers are of rubber, and whether the case has bevelled or plain boards, it does not require to be touched with the folder after it has passed through the machine, so there are no folder marks on the cases. They are turned out quicker and much better than by hand.

MECHANICAL MOVEMENTS.

BY FRANCIS CAMPIN, C.E.

RELEASE AND TRIP MOVEMENTS—CAMS AND CAM BARS.

Release or Trip Gear.—For some particular purposes very sudden movements are required, and such may be obtained by the release of a weight or a spring; preferably a spring, because its motion is more rapid than that of a weight. In order to produce this instantaneous effect, the spring must first be put under strain and then suddenly released. In Fig. 12 such an arrangement is shown. A is a shaft carrying a toothed sector, which gears with a rack on the rod B, to which the sudden movement is to be imparted. This rod is guided at the bottom, and connected there with the particular detail to which its own motion is to be imparted. At the top the rod passes through G, a part of the framework of the machine, and its upper end is surrounded by a spring D, on the top of which rests a washer plate E, and on the top of which the end of the rod B is secured by a nut F. At the back of the rod B is a tooth C, and on a dead centre M fixed to the framing is a pawl I, pressed against the rod by a spring K. Made in one piece with the pawl I is an arm L, which passes behind the rod B as shown. If the sector revolves in the direction of the arrow, its teeth will act upon those of the rack, and the bar will be depressed, compressing the spring D between the plates F and G. The parts are so proportioned that before the sector leaves the rack the tooth C will have been carried below the pawl I, which will arrest its return (against the pressure of the spring) until the striking piece H on the same shaft as the sector, but behind it, strikes the arm L and releases the tooth C from the pawl, when the spring D will be at liberty to act. An indiarubber washer N will deaden the blow upon the plate G. The position of the piece H upon the shaft in its angular relation to the sector will be determined according to the position at which

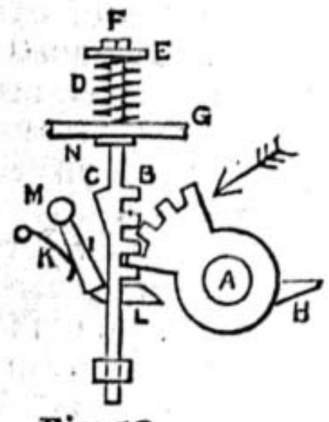


Fig. 12.

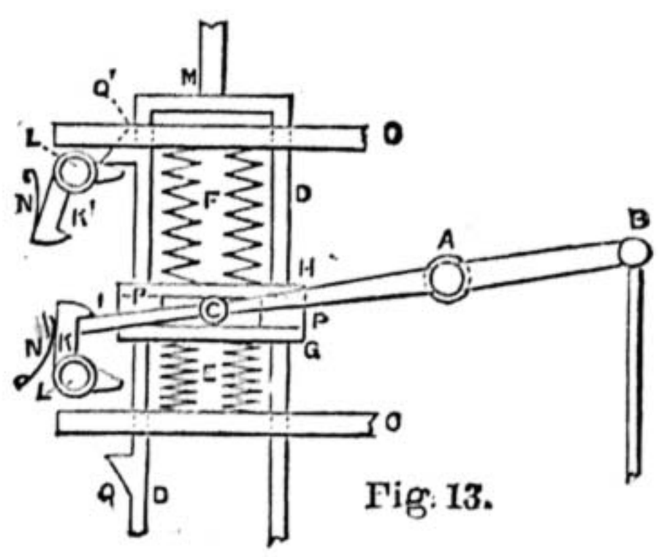
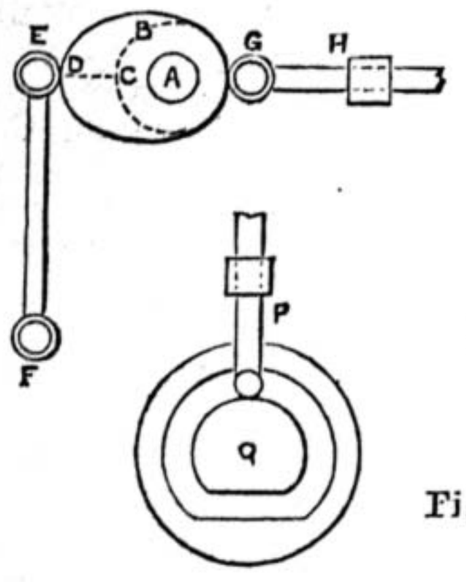


Fig. 13.



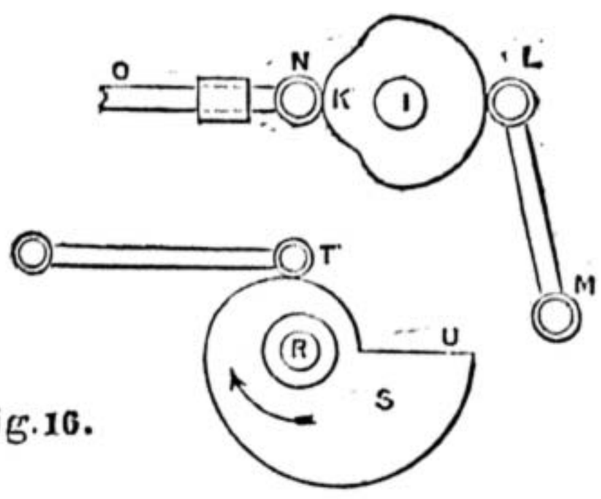


Fig. 16.

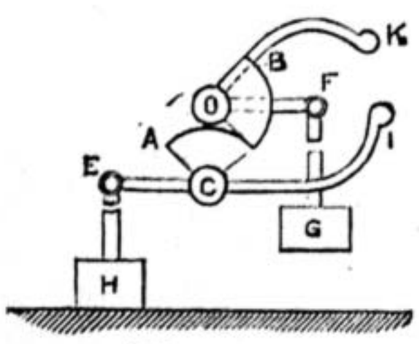


Fig. 14.

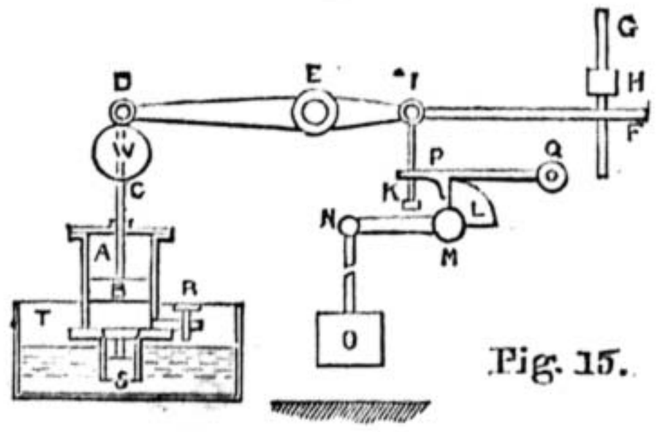


Fig. 15.

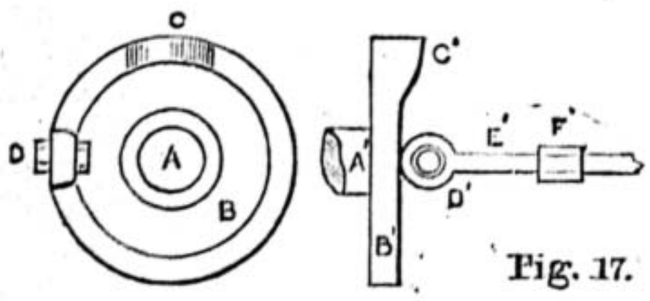


Fig. 17.

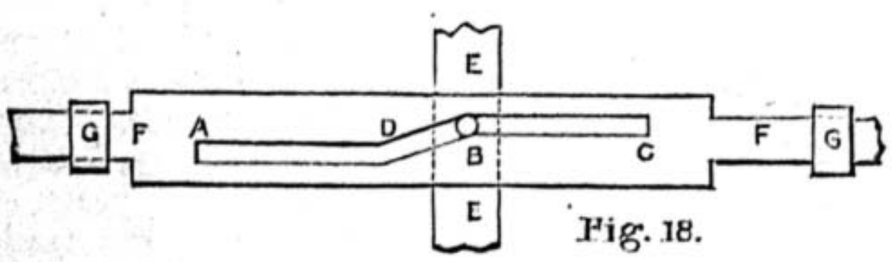


Fig. 18.

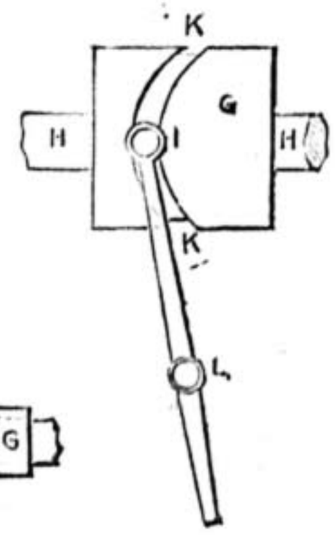


Fig. 12.—Segment and Rack Trip Gear. Fig. 13.—Double Trip Gear. Fig. 14.—Interlocking Quadrants. Fig. 15.—Time Trip Gear. Fig. 16.—Edge Cams. Fig. 17.—Face Cams. Fig. 18.—Cam Bar.

the spring is required to be discharged. The fact of the rod B being held up by the spring D will ease any concussion to which the teeth of the rack and sector might be subject on first engaging together. The amount of tension on the spring D is adjusted by means of the nut F. There may be required a movement which shall act instantaneously in both directions, to operate a valve for instance: this may be managed by means of the contrivance shown in Fig. 13. The valve rod is jointed at B to one end of a lever carried on a dead centre A between the arms of the lever (which is double); on the other side of the centre A is a roller C, lying between two plates G, H, and at the end is a catch I, which engages alternately with the pawls K, K' carried upon pins L, L, and kept in position by springs N, N. To a rod M are fixed two bars D, D, which pass through holes in parts of the framing O, O, and also the loose plates G, H, between which and the framing are the spiral springs E and F. Upon the bars D, D are collars P, P, which cannot pass through the holes in the plates G, H. In the position shown the rod M is at the bottom of its stroke, the spring E is compressed, and the end I of the lever I A B locked by the pawl K. An up stroke being now made, the plate H will be forced up, compressing the spring D, and the tappet Q will strike back the tail of pawl K, the spring E will throw up the plate G, and roller C and the lever top I will engage with the pawl K', and hold up the plate H and spring D until released by the down stroke of the rod M and bars D, D; thus at each end of the stroke of the rod M an instantaneous movement will be communicated to the rod jointed at B to the lever I A B. The roller C may be made of rubber to deaden the noise of contact with the plates G and H. The rod M is actuated from some moving part of the machine to which it is attached. There is an arrangement of mutual release and locking quadrants, Fig. 14, which has been much used in connection with single acting pumping engine valve gear, and which may be applicable to other purposes. The quadrants A and B are keyed on the ends of shafts C and D, which also have arms, C E and D F, carrying at their ends the weights G, H. The details of machinery to be actuated by the rocking shafts are connected with them by arms not shown in the diagram. C I and D K are tappet arms. In the position shown the quadrant B is locked by A, and the weight H is resting on a support to take the strain off the arm C E. If, now, the tappet arm C I is depressed so as to turn the quadrant A through a quarter of a circle, the quadrant B will be released, the weight G pulling the shaft D round; and A will be locked by B until the tappet K is pushed up, when it will be released and the state of affairs shown will be restored. A trip gear set to act after a certain interval is shown in Fig. 15. A is a cylinder like a pump

* I do not burke Mr. Clarkson's aspiration as I might, but I must say I am in no way in sympathy with it or him. To many, as to myself, a trimmed periodical is an abomination, for when the binder, who is employed to bind the parts or numbers, as the case may be, into a volume, has had *his* turn at the edges, the margin is so much reduced that the book may be said to be disfigured for life. I never use forefinger, walking-stick, or umbrella to cut even a newspaper, much less a periodical; and for my part I prefer even bound volumes to have rough edges, and whenever I have the happy chance of indulging my proclivities in this respect my books are bound so.—ED.

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barrel fitted with a piston B, an outlet cock R, and an inlet valve S. To the piston B, which moves water-tight in the cylinder A, is fixed a rod C passing through a hole in the cover (which is perforated to allow the air to flow freely in and out, as otherwise it would affect the motion of the piston), and on this rod is a weight W, and the top of the rod is connected by a pin at D with one end of the lever D F working upon a fixed centre at E. The rod G passes through a hole in the end F of the lever, and has a collar H that will not pass the hole. The trip gear consists of the quadrant L on a rocking shaft M, carrying the arm M N and weighted rod N O. The quadrant L is locked by the tooth on the catch P Q, pivoted at Q; through this catch passes a rod I K, pivoted at the top to the lever D F, and made with a collar at the bottom to lift the catch P Q. The action is thus: The rod G descending, depresses, by the collar H, the end F of the lever D F, and raises the end D with the weight W and piston B drawing water freely through the inlet valve S from the tank T; the rod G then ascending leaves the weight W pressing upon the piston B to force out the water from the cylinder A through the cock R. When the piston reaches the bottom of its stroke, the rod I K is lifted, and the catch P Q with it, releasing the quadrant L. The time taken by the piston B making its down stroke will depend upon the extent to which the cock R is opened, and during that descent the machine controlled by it will be at rest.

Cams and Cam Bars.—The cams and cam bars are innumerable, and in this article I have only space to show the principles of the chief types. Cams may generally be divided into edge cams and face cams. Of the former some are shown in Fig. 16. A is a shaft carrying a cam B, by the revolution of which the roller E on the bar E F, pivoted at F, is caused to oscillate through the distance C D, or the same amount of motion is given to the roller G on the rectilineally moving rod H. The cam K on the shaft I gives several movements during one revolution to the rocking bar L M on the sliding one N O. S, called a snail, revolves with the shaft R in the direction of the arrow, and gradually raises the roller T, letting it drop suddenly when the point U reaches it. In all these cases the roller upon which the cam operates must be held in contact with it by weight or spring, and where this is not desirable the modification P must be used. In appearance this is a disc turning upon a shaft Q, and having cut in its face a groove in which a pin or roller attached to a rod receives its motion, being positively controlled throughout the revolution by the groove; in action this is an edge cam. In Fig. 17, B is a face cam running on a shaft A; the cam is a disc with one or more elevations C on its face near the periphery, which passing under the roller D impart motion to it parallel to the axis of the shaft A, and so moves the rod E′ working in guides F′. The letters A, B, C, D, refer to the front elevation, and A′, B′, etc., to the side elevation. One great disadvantage attending cams of this class is the bending strain, which tends to loosen them or their shafts. In this example the roller must be held up to the cam unless the modification G is used, which consists of a barrel on a shaft H H. The roller I at the end of the lever pivoted at L works in a groove K K, cut on the periphery of the barrel; thus the motion of the roller is controlled throughout the revolution. Fig. 18 shows an example of a cam bar. F F is a bar moving rectilineally in guides G, G; in it is a slot A B C, in which works a pin or roller D, fixed to a bar E E, which is capable of movement in a direction at right angles to that of F F. As the latter bar is moved motion will be given to the bar E E by the action of the inclined part B of the slot A B C upon the roller D. Cam bars are also used acting against one another by inclined surfaces, in which form they are pre-eminent for the amount of friction occurring. It is easily seen that all kinds of intermittent movements may be obtained by means of cams, and they are easily set out. It must be noticed, however, that the angles made between the directions of the pressures and resistances should be as large as possible, in order to keep the friction down.

In the first paper on this subject I referred to the action of the fly-wheel in equalising the motion of machines. Its action is that when an excess of work is being done during one part of a revolution, that excess is taken up and stored in the fly-wheel, the velocity of which is slightly increased thereby; and when the work done upon the machine falls short of the resistance, the stored-up work in the fly-wheel is given off, and its velocity falls. Thus, the total work done on the machine being equal to the total work done by it in one revolution, the fly-wheel serves for the more uniform distribution of work over the period of that revolution.

THE ART OF GRAINING.

BY A LONDON DECORATOR.

Mechanical Aids Thereto: Patents and Special Materials.

So far as may be possible within the limits of a short paper, I purpose herein to bring before the general readers of Work, and especially to the notice of those interested in graining, some particulars of the many inventions in tools, processes, or materials connected with my subject, which have been put upon the market within a comparatively recent number of years. In compiling this article, I have remembered the world-wide and cosmopolitan circulation of our technical magazine, and have, therefore, directed attention towards some specialities which—although not indispensable to a full and proper knowledge and acquisition of the imitative art—are, nevertheless, likely to prove of practical utility to the very occasional imitator of woods.

Oak Combing Rollers (Figs. 1 and 2) are the most serviceable of the "mechanical aids" that have so far come into use. Notwithstanding this invention has been known and used for nearly a score of years, I am confident there are many in the trade who are still unacquainted with it, and, therefore, are ignorant of the assistance it may give to the worker when graining ordinary oak. This simple arrangement was first used, I believe, by a prominent Manchester grainer—Mr. William Jones—and one who still takes an active and leading position in the trade there. In noticing these tools, the advantages of an illustrated magazine are very apparent—one's description is much simplified and the reader's interest thereby secured. Although I have been informed that such an arrangement of circular discs has been made and used successfully in leather, such have not come under my own observation. The present construction of the rollers is with iron handles, which contain the small roller or axle whereon the metal discs revolve. The latter are usually made of sheet zinc, being stamped, or cut, in circular form, and afterwards notched out at different intervals around the circumference. Each of the wheels, if I may so term them, is placed upon the cylinder, and revolves loosely and independently of any other, so that given a number of these discs, and each notched out, they will ensure a succession of short fine lines of various irregular lengths and spaces apart. I have known many grainers to make their own rollers, and this some of the readers of Work will probably undertake; I therefore reproduce separately a single roller (Fig. 2) and the "feeding brush" (Fig. 3) specially made for the rollers.

I have previously explained how steel and leather combs, with various sizes of teeth, are manipulated in order to obtain the effect of the dark pores we see in oak and some other woods, this being effected *before* wiping out the lights or figure. When the grainer uses the rollers under notice, he proceeds on a different plan. The oil graining colour, which can be used somewhat thinner than with combing, and which needs no megilphing, is spread in the ordinary way, and the "lights" and half tones wiped out as instructed. When dry, upon the inverse principle, the grain is put on by using a thicker and darker graining colour. The feeding brush is charged with colour, and then held against the handle of the roller—as indicated by the arrangement shown on the brush handle—by the left hand. With the right the roller is held, and the two hands then cause the roller to travel up the panel from the bottom to top with a slight but steady pressure. The metal discs thus revolve, and, in so doing, the edge of each is charged with colour from the face of the brush, and transmitted thence in fine irregular lines—"grain"—upon the work. Those readers who may succeed in making a useful roller of about 2 in. wide, may also save the expense of a proper feeding brush by using a partly worn paint tool of the larger sizes, such as Nos. 9—12 (Fig. 4).

The intelligent student will scarcely need telling that where the "lights" are wiped out, the pores made by the roller must also be cleaned away with rag, and the roller grain should then be softened off lengthways with a badger, or large dry tool. Care must be taken to obtain clean, sharp rolling, and also in getting the pores all running at one perpendicular, or the natural, angle of the grain. "Oak graining rollers" can be used both in distemper and oil colour. They are retailed complete, six in the box, with brush, as shown, for about 18s.; whilst a 6 in. roller and brush in a box are sold for 8s. The price for single rollers is—½ in., 1s. 7d.; 2 in., 2s. 6d.; 4½ in., 3s. 9d.; and 6 in. for 4s. 6d.; the brushes corresponding to these sizes being 9d., 1s., 1s. 9d., 2s. 6d., and 3s. 6d. each.

Patent Graining Machines, or rollers, have been in the market now for many years. Upon reference to the illustration (Figs. 5 and 6), the construction and working of these tools will be readily apparent. A frame with wooden handle—similar to a paperhanger's roller—is affixed to a revolving cylinder. The surface of the latter is covered with prepared leather, and the pattern of the figure is then conveyed to its face. Similarly to the means used in making a wood engraving block, the ground of the leather is then chased away, leaving the pattern in relief. The action is reversed in working, however, since the graining colour

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is spread all over, and the roller *takes out* the figure. Graining machines for oak and most of the woods are only made in the form of the woodcut (Fig. 5), I believe, but of varying sizes; for imitating Spanish mahogany and similar woods, the roller is made very similar in shape to the paper-hanger's tool—viz., small in circumference, and much wider than that of oak (Fig. 7). The piece of leather upon which the pattern is inscribed is then fastened along one end only to the roller, and is long enough to go round the cylinder twice or thrice. When in use the unfastened end is pressed against the top of a panel, and the leather thus unrolled against the work. The right hand works the tool, whilst the left cares for the loose end of the leather (see woodcut). These graining rollers, the principle of which is also carried into rollers for marbling, are manufactured by Mr. J. F. Bellamy, 83, Offord Road, London, N.; and as they are termed "Bellamy's Patent," I conclude they are the invention of the maker. All large brush retailers can, however, supply the rollers, and since also with them full directions are given for using, I need not go into that matter here. As some criterion of their value, I may add that a 3 in. roller costs 16s., a 6 in. one 26s. If we consider the nature of the tool, and the amount of wear they stand, the price is very reasonable; and, although the amount of "art" displayed by the worker who uses them may be difficult to discover, I am well aware that for graining cheap furniture, and such-like purposes, they have been used largely and satisfactorily from every point of view.

"*Gransorbian*," or *Photo-Graining Paper*, is a very recent invention in graining, but one that is so far in advance of any other introduction the trade has yet seen, that one competent English authority, after careful testing and examination, pronounces it as likely to create a practical revolution in the whole process of graining. Without questioning the reliability of purely trade journals in general, I may here point out that it is only natural when, as is often the case, the sample to be tested is accompanied by a good order for advertisement space, the writer of the notice can scarcely bring an unbiassed and independent mind to bear upon the merits of an invention. When the financial and editorial issues are vested in one and the same person, it is, therefore, often advisable to take such notices of new inventions and patents carefully — *cum grano salis!* Gransorbian is, however, a "good thing." The invention is described as a photo-graining paper, and consists of a surface in relief, which is of an absorbent nature—presumably a sort of thick blotting paper—so that when brought into contact by pressure with the wood, it takes up the colour in the same way as do the graining rollers. The great superiority of Gransorbian appears to lie in the splendid selection of figure the user has at command, each pattern being 78 in. long before repeating, and in the fact that it may be used, when graining in oil, from twelve to sixteen times, and when in distemper from sixteen to twenty times. The width in which it is manufactured is a standard one of 24 in.; so that, given a piece of work 6 in. wide, the pattern, when cut into four, would grain 26 ft. before the design repeated. Taking it as possible that one piece *can* be used twenty times in water graining, it follows that the vendors promise that about 2¼ lineal yards will execute for us 520 ft. of a pattern, 6 in. wide—all this for the insignificant outlay of 1s. 3d. per yard.

Gransorbian is made in no less than fourteen varieties, consisting of four kinds of figured oak, two of sap oak, two of pitch pine, and one each of pollard oak, walnut, mahogany, Hungarian ash, English ash, and maple. In graining oak, the ordinary combing process is utilised on the stiles, but the panels, and lock rail if covered with "sap," are best only evenly laid off. The patent paper having been cut to the size of panels, it is now carefully brought into contact with each panel, and the pressure of a small roller being passed over the back, the imitation is effected. The material is very absorbent, so that it should touch the painted surface only when in its exact position.

From the foregoing it will be apparent that, whilst a person of very little practical experience may easily succeed in creditably graining any quantity of plain surface work, it requires the practice and judgment of a competent grainer to use the "paper" to the best advantage, and then to finish and overgrain the work.

I have seen it stated that a church at Colne was grained throughout by Gransorbian at a cost for material of only 7s. 6d.

At the present time, the photo-graining paper is quite a new thing to the trade and the public in general, but the inventors are confident that it has a grand future of usefulness before it. One of the drawbacks to a large sale is, to my mind, the sum required for a sample lot, viz., 20s. It does not require many yards to practically test a process such as this, and if a few small pieces about 24 in. long were supplied as samples for about 2s. 6d., the proprietors would, doubtless, find a more rapid and increasing demand for their invention. The sole manufacturers are the Gransorbian Photo-Graining Company, Limited, 27, Water Street, Liverpool, from whom any further particulars can be obtained, and who also supply a special leather-covered roller at 1s. 6d. as well as graining colour put up in tins of various sizes.

By the courtesy of the Gransorbian Company, I am able to reproduce, in Figs. 8 and 9, samples of the figured and sap oak, respectively, executed by their process. No. 8 would correspond with a panel about 24 in. by 15 in., and will enable the reader to see the natural arrangement of the lights, which I believe has been taken from real oak. No. 9, besides showing the variety in which sap oak is made, will also furnish the student with an excellent copy for imitating in the hand methods.

Mathieson's Oak "Scumbling" is the name given to a specially-prepared material for graining, and is the last of such articles that I need dwell upon herein. This introduction, which hails from Scotland, has been put upon the market as a complete and perfect substitute for the various preparations of pigments, driers, etc., that are usually compounded by the worker into "graining-colour."

"Scumbling" is the technical term such mixtures are given in the North, and that under notice is manufactured by a practical grainer who undoubtedly understands what characteristics proper graining-colour should possess. Without unduly analysing its nature and parts, I may here state that it has the appearance of a pigment ground into a stiff paste in prepared linseed oil. Its practical and serviceable nature may be still further indicated by the fact that it requires no addition of a drying agent, but simply thinning with linseed oil and turpentine, in proportions to suit the time allowed for its drying. For special purposes, it may even be made to dry in one hour if diluted with liquid drier instead of oil. I would here caution the learner against unduly forcing the drying of oil paint of any nature by large excess of driers unless such is absolutely necessary. It should be borne in mind that the oxidising action, set up by a drying agent and the atmosphere, does not cease with the drying of the surface, but continues, and in reality brings about a consuming and destroying process, when the drier is *greatly* in excess of its proper proportion. Besides being equally serviceable for both in and out-door graining, the scumbling makes an admirable stainer for wood. For staining a rich and deep-colour margin around the floor of a room in the style now so general and popular, nothing could be better, I believe, than the "dark" shade thinned with linseed oil, and I am certain nothing would be as cheap or durable. "Mathieson's Scumbling" is the invention—if I may so term the article—of Mr. Edward Mathieson, and its manufacture is now largely carried on by Messrs. Mathieson Bros., Ardrossan, near Glasgow.

With reference to the *colours* of the graining-colours for oak which Mr. Mathieson, as a grainer of long and practical experience, advocates by his "Scumbling," I may be pardoned for here noting that they fully support my own instructions in these papers. I have previously expressed an opinion that were the process of oak graining in oil necessarily confined to raw and burnt umbers only, there would be a general gain rather than loss in natural colouring. Of the three shades in which this scumbling is prepared, the lightest seems no darker than good raw Turkey umber; whilst with the dark, the natural richness of the burnt pigment appears very prominent.

Mr. Mathieson, who is not only a practical man, but a lucid writer upon the subject, evidently considers *three* degrees of colour, "light," "deep," and "dark," to be sufficient, either used separately, or when compounded, for nearly all varieties of oak graining. The preparation is sold in three qualities at prices ranging from 25s. to 56s. per cwt. Having, personally, tried the scumbling, and finding it fully up to the position of useful merit claimed by the makers, I strongly advise those professional workers who are numbered amongst the readers of WORK—and they are not a few I am well aware—to try it and judge for themselves. Comparing the simplicity of having to dissolve the scumbling with liquid only to the ordinary process of taking "so many parts of pigment" and so many of driers, etc., the bother and time the former saves is a matter of moment to the professional grainer; and, furthermore, when such an article is sold at the price of a good pigment only, there can be no questioning its practical claim to notice in this paper. For the assistance of the occasional grainer, the makers have arranged to dispatch a sample tin—nearly 1 lb., or sufficient when diluted with oil and turps to grain the woodwork of a room—with instructions, post free, upon the receipt of nine penny stamps, and 7 and 3 lb. tins for 4s. and 2s. respectively. To many readers this will be a great boon.

Having now discovered to the student to what extent the practice of imitating woods may at the present day be aided by mechanical and special aids, this suggestive thought may come to the mind of the reader: "If graining can be executed so

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well by patent rollers and patent paper process, what great advantage has the hand and brain worker over such methods to compensate him for his study and labour? To such a thought I would make answer by sketches, etc., by good artists? Far from it! but rather serves to educate the community to a higher knowledge of such matters, and therewith a demand for truer work from the individual artist. So with practically following my advice and instructions, that such mechanical processes as Gransorbian are scarcely likely to affect the marketable value of a good grainer's skill; and, as the best evidence of this, we have the

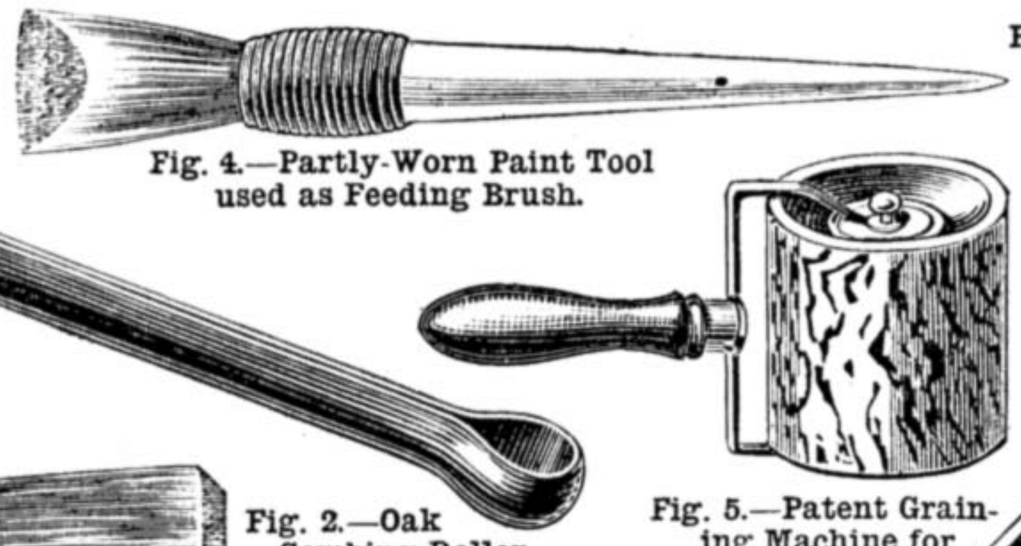


Fig. 4.—Partly-Worn Paint Tool used as Feeding Brush.

Fig. 2.—Oak Combing Roller.

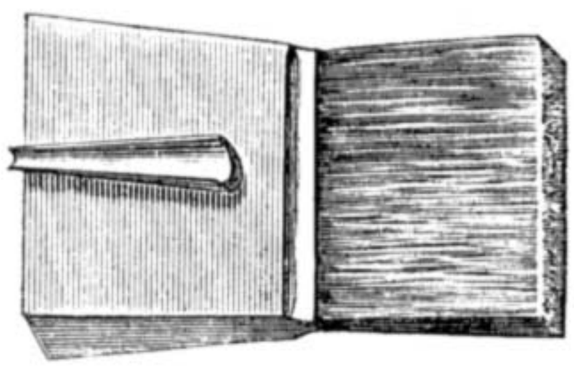
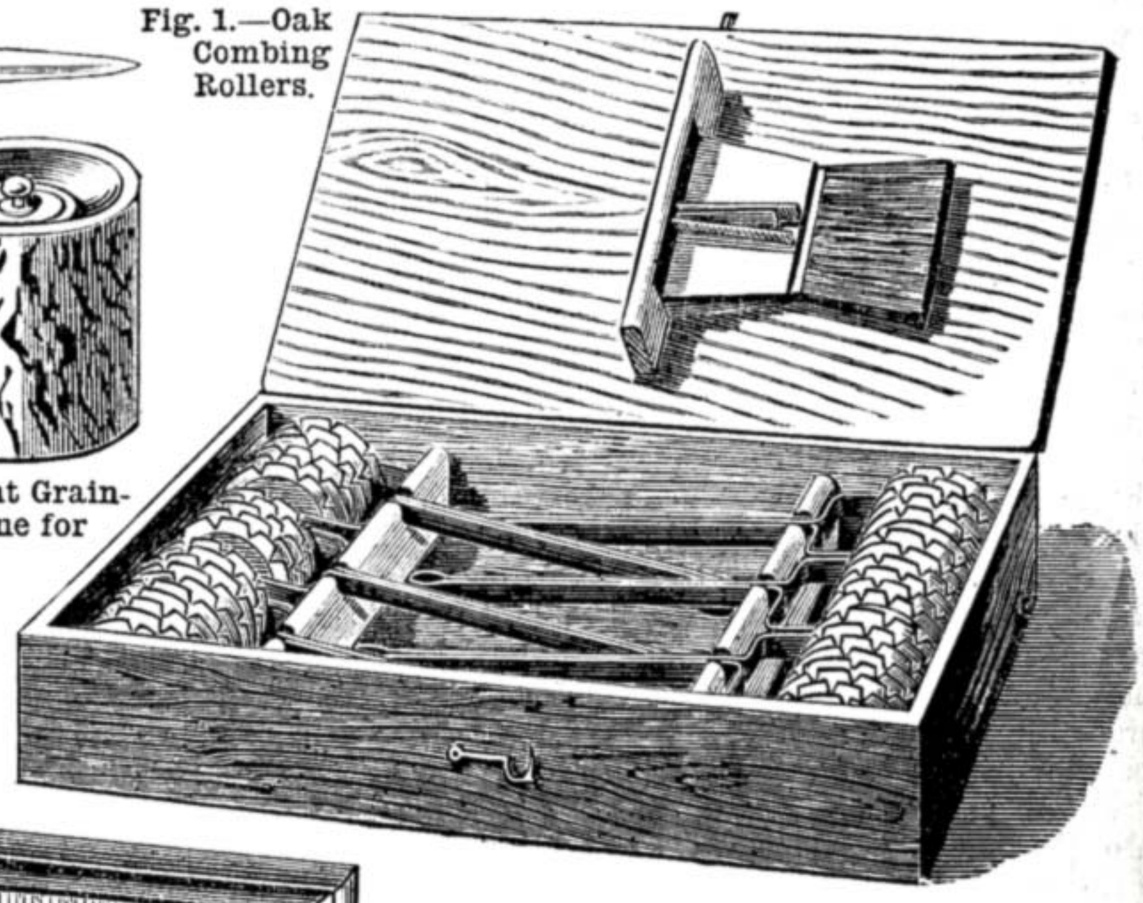


Fig. 3.—Feeding Brush.

Fig. 5.—Patent Graining Machine for Oak.

Fig. 1.—Oak Combing Rollers.



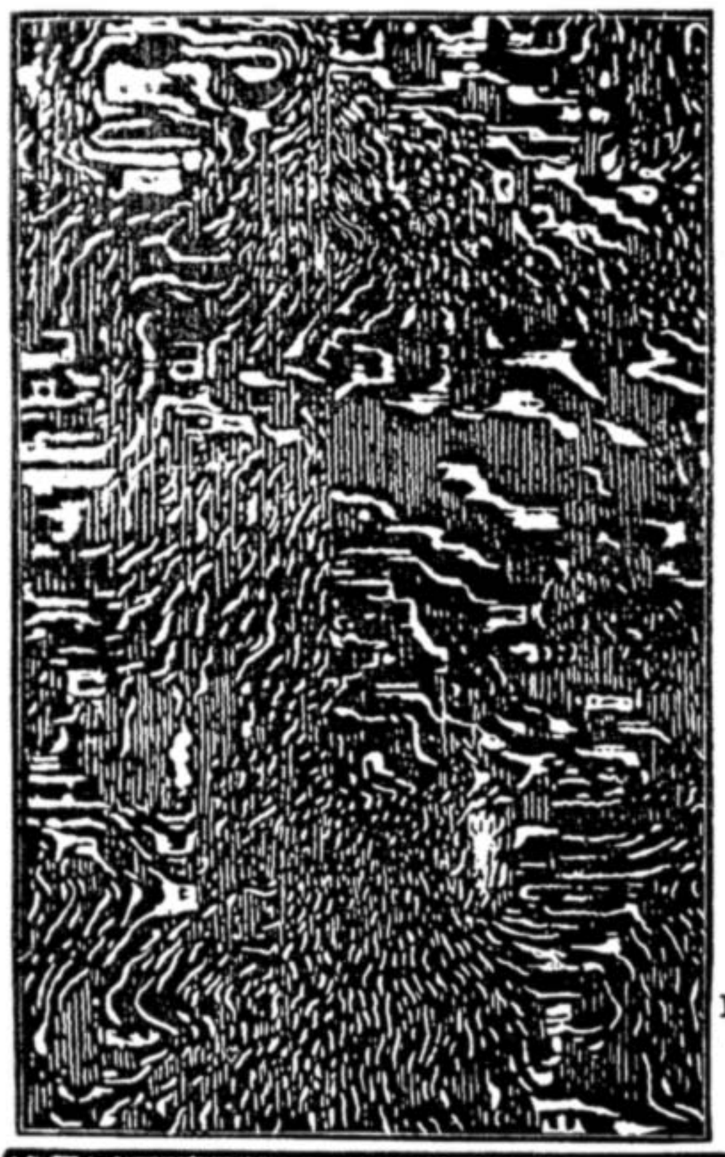


Fig. 8. — "Gransorbian" Company's Figured Oak.

Fig. 6.—Patent Graining Machine in use.

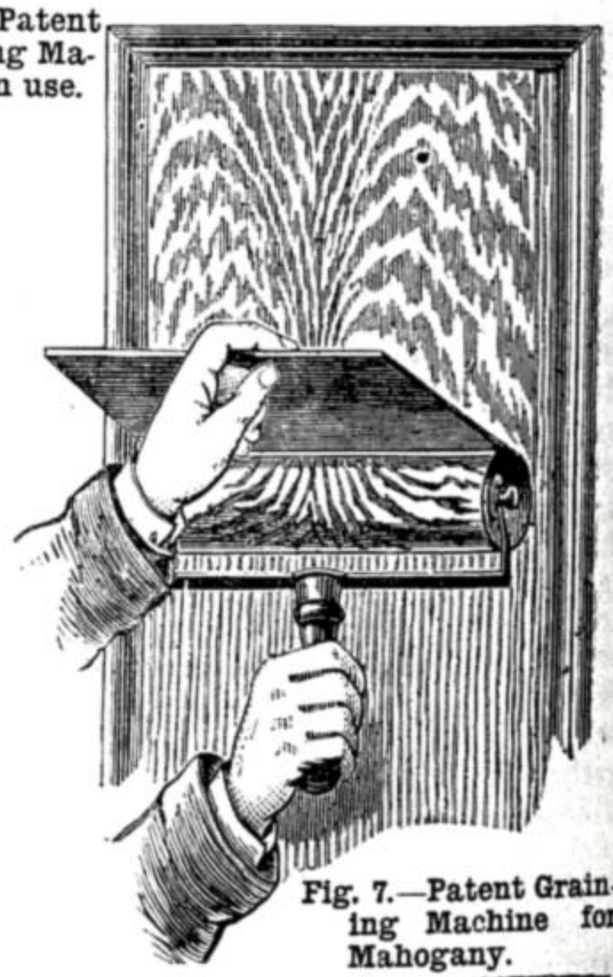


Fig. 7.—Patent Graining Machine for Mahogany.

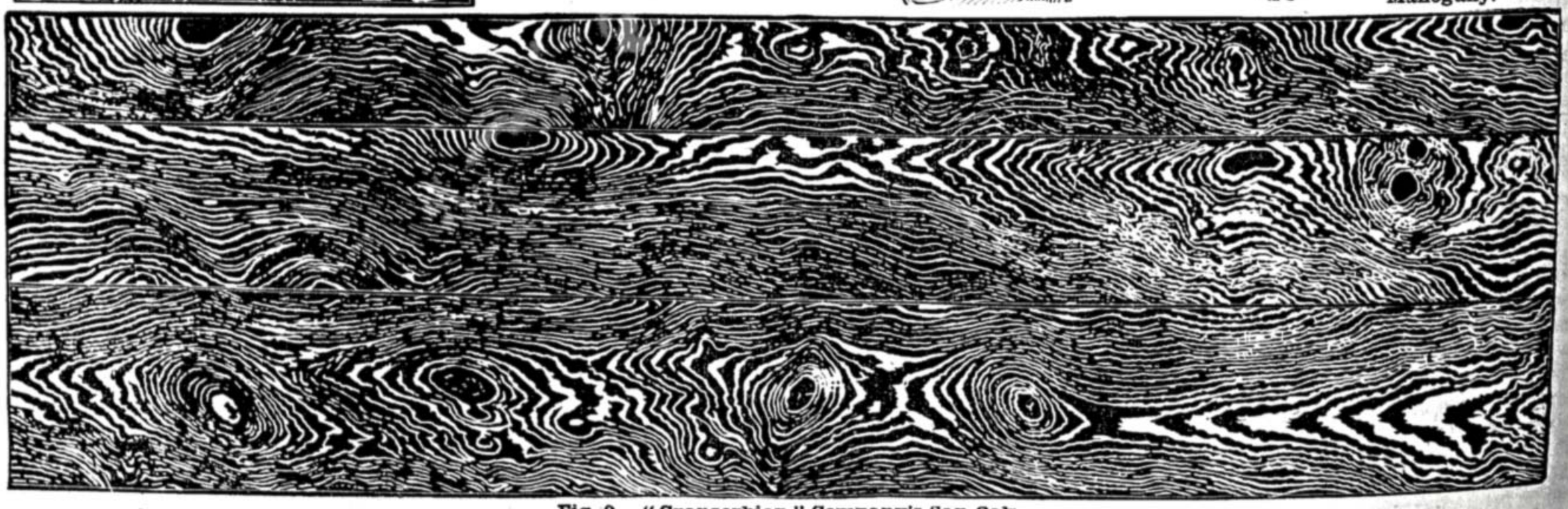


Fig. 9.—"Gransorbian" Company's Sap Oak.

another similar question: "As oleographs, chromo-lithographs of water-colour works, photographs, and cheap etchings can be produced so cheaply, and yet so artistically as we find them at the present day—will, or does, this tend to lower the artistic and commercial value of genuine oil paintings, the art of graining; for the successful introductions of such patents and materials as I have noticed are sure signs of an awakening to the true artistic and utilitarian merits of the craft.

Beyond this I may state, for the encouragement of those readers who may be knowledge that at the present time a high-class and costly work on hand graining is being brought out by the same critical authority who believes "Gransorbian is destined to revolutionise the process of graining."

Messrs. Crowden & Garrod, 62, Southwark

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Street, S.E., and Messrs. Hamilton and Co., of Soho, the well-known London brush manufacturers, are agents for most of these specialities, besides smaller but equally reliable firms such as Brodie and Middleton, Long Acre; J. Hill, Pentonville Road, N.; and Pavitt and Sons, Southampton Row, W.C.

CARVED PANELS FOR HANGING CABINET.

BY FRED MILLER.

The Chrysanthemum as a Motif.

Man is a tool-using animal said the professor in "Sartor Resartus," and that accounts for the popularity of wood carving as an amusement. It is finger occupation like such woman's work as knitting, and yet it is more than that. It makes demands upon the fancy, judgment, and invention, especially when we originate our own designs, as all wood carvers should be desirous of doing. In the course of these notes that accompany the various designs for wood carving I have contributed to the pages of Work, it has been my endeavour to explain the principles of designing, for it is an extremely difficult thing to offer the tyro that kind of assistance he stands in need of when he essays to design his own work. I should always take nature as our starting point, and my aim is to so adapt and bend natural form to suit the particular work in hand. I have spoken elsewhere on "knowing what to leave out" as an artist's first duty, and this principle has very particular application in the case of wood carving, for it is apparent at the outset that there is very much in plant form that cannot adequately be rendered by the means at our command. Grinling Gibbons has shown us how far in an imitative direction wood carving can be carried in those wreaths and festoons of flowers and fruit he was so fond of working. He compels us to admire such work because of his skill in almost hiding the insurmountable difficulties he tried to overcome—we admire such work as a *tour de force*—but I feel that that is not the direction wood carving should be carried in a general way, and very few wood carvers, either professional or amateur, have such a command over their tools as to carve us a lily with the petals almost as thin as the real flowers. I lean to the Gothic school of wood carving, which is content with a much simpler character of work; which does not attempt anything in the way of imitation; which has robustness, vigour, an almost archaic simplicity, in place of gentility and womanly rather than masculine grace. It always

Carved Panel for Hanging Cabinet—The Chrysanthemum as a Motif.

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seems to me better to succeed in a quiet unaffected way than to fail by aiming too high, and as long as we keep to well-known plant forms, attempting no great amount of relief, and just simplifying and fitting in the growth to the particular space to be filled, we cannot help succeeding, seeing that we are never hazardous and so court failure.

In panels such as that given in this number for a hanging cabinet we can, as our work is concentrated, attempt a little more elaboration than if our work were on a large scale and extended over a large surface. I will now select, taking the latter for our present consideration, such well-known forms as the poppy and chrysanthemum as the *motifs* of our work, and I will endeavour to explain what ideas guided me in drawing the panels, for my object in writing these notes is to teach my readers how to design their own work. If I were working direct from nature, *i.e.*, suppose I did not have drawings of the plant by me, I should first of all make a study of some characteristic piece of chrysanthemum, and in choosing the specimens to draw our power of selection can be shown. Don't take too complicated a specimen—where the growth is too full and prevents us seeing the skeleton, as it were. And do not choose a specimen that is eccentric through some malformation or personal peculiarity, for in our carving we want to give the first principles of plant form; we want to lay hold of *the* character of the plants. Make a careful study in pencil, or sepia, or charcoal (I would not trouble about colour, as this tends to confuse one and may prevent one seeing the general form and growth) life size. I always make my studies life size, for it is easy to reduce afterwards, whereas in working from one's own studies one is apt to get the work out of proportion, if the study is not life size. Note all these peculiarities and characteristics of the plant: the way the leaves articulate from the stem, the curves and angles the stems themselves take, the contour of the leaves, the way the flower is set upon the stalk, and so on. Don't think about minute points such as how many veins there are in a leaf (though you will observe the deviation the veins take and any striking feature about them) or the number of serrations to the leaves (though of course you will notice the form of such serrations); these are matters that more concern the botanist: go for breadth, mass, line, for these characteristics you *can* reproduce, and if you miss such important features your work will be tame and wanting in nervous force.

The companion design—a study of the poppy—will be given very shortly, and I may add that the remarks made here on the treatment of the chrysanthemum will apply equally to that of the poppy, and *vice versâ*.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

37.—Stick-all Cement.

This is a new patent cement sold wholesale by the "Everclean Collar Company," 100, Wood Street, London, E.C., and supplied in self-opening tins at 6d., or in larger tins holding three times the quantity at 1s. The cement is said to be sold retail "everywhere," which means, I suppose, as trades are getting very mixed in these days, and one can hardly tell where each really begins and ends, by stationers, oilmen, grocers, and by some chemists and druggists. The Company, however, send sample tins post free for 9d. and 1s. 3d., according to size, to any persons who may not be able to get it from any retail dealer. The manufacturers say: "It is very tenacious, and will securely stick paper, leather, wood, ivory, marble, earthenware, iron, stone, indiarubber, or any other substance." Its adhesive properties are really marvellous, but I have not had time or opportunity of testing it on earthenware, iron, or marble. It is easily applied. The contents of the tin should be liquefied by placing the tin on the hearth, over the gas, or in hot water. If too thick and viscid, water may be added to thin it.

38.—Watkins' Exposure Meter.

I have received from Mr. Alfred Watkins, of Hereford, one of his new Exposure Meters, which are supplied by Mr. W. E. Haines, photo chemist, Hereford, and by many other dealers in photographic appliances, at 12s. 6d. each, or 12s. 9d. post free. It is convenient to state here that rolls of bromide paper for refilling are supplied at 7d. post free. Mr. Watkins tells me that it is a decided success, although only just brought out, and this I can readily believe, as one of the points which is most perplexing to an amateur photographer is the time of exposure. He further tells me that "W. Jerome Harrison, Esq., F.C.S., author of a 'History of Photography,' writes—'I consider it a well-conceived, ingenious, and very useful instrument. I have carefully tested it and found its indications to be correct. I congratulate you on perfecting so complete an instrument.'" Mr. Watkins further writes—"A few days ago I exposed with its aid four negatives: a cloud picture $\frac{1}{2}$ second exposure; an evening landscape, 4 seconds; interior, mantel-shelf, 7 minutes; old oak cabinet, bad light, 65 minutes. All developed together at the same time in one dish, and all came out equally good and correct negatives." The Exposure Meter will calculate the proper exposure of photographic plates under every imaginable condition. The nature of the instrument may be seen from Fig. 1. It consists of a brass tube $1\frac{1}{8}$ in. in diameter, with a cap at each end. The interior is divided into two chambers, one of which contains a simple actinometer in the form of a strip of bromide paper for testing the light, which acts on the bromide paper through a hole in the cap by which the chamber is covered, and the other a chain pendulum for counting seconds or half seconds, for

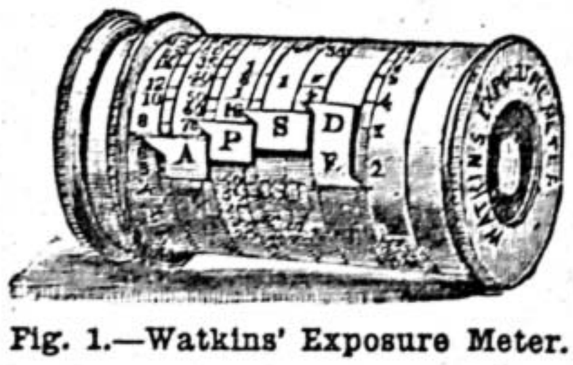

Fig. 1.—Watkins' Exposure Meter.

timing both the actinometer and camera exposure. On the tube, between the milled rings against which the caps close, are six flat rings, two fixed, and the others movable. All of them are suitably graduated, and the four movable rings carry each a pointer, the first being lettered A (actinic force of light falling on the subject), the second, P (the sensitiveness of the plate), the third, S (the colour or character of the subject), and the fourth, D (the diaphragm or stop used). Below D is a fifth pointer E, which indicates the correct exposure on the fixed ring next to it, when the other pointers have been so placed as to indicate on the rings next to the left the numbers representing the value of each factor. Full instructions showing how to use the appliance, and a valuable paper read by Mr. Watkins before the Hereford Photographic Society on "The Mathematical Calculation of Exposures" (which will be forwarded to any applicant on receipt of a stamp for postage), is sent out with each instrument, which promises to be a most valuable addition to the stock-in-trade of the photographer, whether he be an amateur or professional.

39.—Ellicott's Patent Cartridge Case.

Mr. William Ellicott, Broad Street, Launceston, wishes me to call attention to his Patent Cartridge Case with Coned Base, a section of which, exhibiting the interior and construction of the cartridge, is shown in Fig. 2. It is intended for use in sporting or military guns or small arms. The case is $2\frac{3}{4}$ in. long, and is made with a solid drawn cup of metal with a coned base forming the base and lining of the powder chamber. It differs in this respect from the ordinary cartridge which was made with a flat base, and this prevents the waste of powder which lies round the edge of the bottom of the flat base and below the flash hole. The form of cartridge introduced by Mr. Ellicott ensures a more complete and certain ignition and combustion of the powder in the powder chamber, and

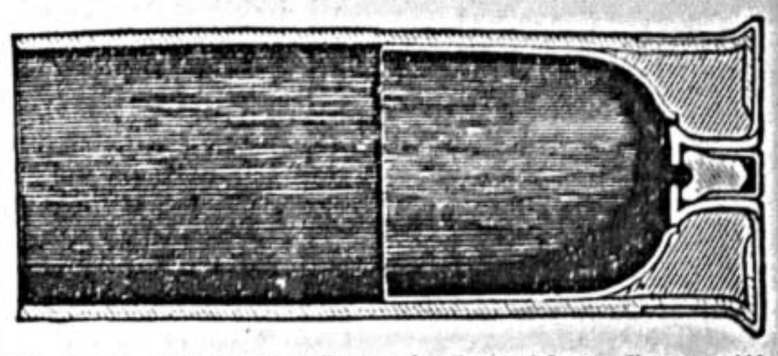

Fig. 2.—Ellicott's Patent Cartridge Case with Coned Base.

greater safety, inasmuch as bursting at the rim is impossible, the reaction of the gases taking place on the sloping base of the cartridge, and the lateral strain and recoil being thus reduced to a minimum. The metal lining is so arranged that with 42 grains nitro powder pressure shall be uniform, and this uniformity of pressure and protection at the point of strain renders the cartridge especially well suited for nitro compounds and ejector guns. The disadvantage of the absorption of the strength of nitros by paper-lined cases is completely done away with by the adoption of the cupped metal lining, and it has been found that cases of the new style of cartridge with coned base leave the gun in better condition than any other. Mr. Ellicott says that the Martini cartridge would not jam if made on his principle. Although only just put on the market, it is approved by all sportsmen and military men who have made trial of it. For cartridges of No. 12 gauge the price is 4s. per 100, or 4s. 6d. post free.

40.—Parkinson's Gas-Burner Regulators.

An effective and reliable gas-burner regulator is a good thing, undoubtedly, and anything of this kind that is of obvious utility should find a place in "Our Guide to Good Things." My attention has been called to this burner regulator by a correspondent who writes from Birmingham where they have been used in the workhouse since 1883, when 1,500 of them were fixed and are still working satisfactorily. He writes—"I send you a burner; it is an automatic one for regulating the supply of gas, which the makers guarantee it will do for a lifetime. The only thing it requires doing to is cleaning by taking it to pieces every two or three months. I myself have tried this one that I send you at all pressures up to $2\frac{1}{2}$ in. of pressure, and have found it correct. The burners are made in seven sizes to pass from 2 to 8 cubic feet per hour. The price is 14s. per dozen, or a sample is sent post free for 1s. 3d. by the patentees, Messrs. G. J. Parkinson & Co., Birmingham. It is claimed for these burner regulators that there is a saving of from 30 to 50 feet of gas consumed under ordinary circumstances; that perfect combustion and increase in the illuminating power of the gas is insured, and that the lights burn steadily and silently; and further that it is the smallest and most compact regulator burner that has yet been produced, and will repay its cost in a few weeks' use by the gas saved.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

NOTICE TO CORRESPONDENTS.

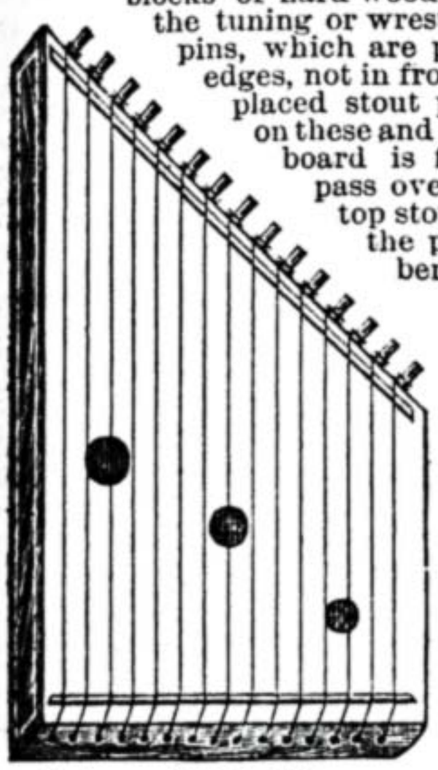
*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Mitre Cramp.—CODGETO writes:—"I would like to ask H. B. (*Chatham*) (see page 111, Vol. II.) what is the size of the block A, as it must be a certain size or it will not cut a true mitre. KILDONAN (see page 636, Vol. I.) says it must be a perfect right angle, but I say it must be of a certain size, or when the mitre is cut and put together it would make a frame after the style shown; it would not be square. If H. B. will please send me the exact size, it would be very useful, not only to me but to many others, especially amateurs like myself. If the writers in WORK, when sending a design, would indicate the exact size, it would save a lot of trouble and time."

Zither.—R. F. (*Norwich*) writes:—"The instrument illustrated by J. D. (*Dublin*) (see page 654, Vol. I.) is known in the trade as 'Prince of Wales' Harp,' and may be purchased of any musical instrument dealer, who, if he has not got it in stock, will order it. They are very easily made, and consist simply of a shallow box, having at top and bottom blocks of hard wood for the insertion of the tuning or wrest pins, and the hitch pins, which are placed in the outside edges, not in front. At the sides are placed stout pieces of wood, and on these and the blocks the soundboard is fixed. The strings pass over bridges having on top stout brass wire to take the pressure. The number of strings vary from eight to nineteen or more, and the size of the instrument and length and size of strings depend entirely upon the pitch required. The zither proper is an instrument of a vastly different character, and is quite outside the range of 'Shop,' although it is quite within the capabilities of a good amateur to make; but it would require an article to itself to do it justice. I send a sketch of the 'Prince of Wales' Harp.' J. D. will observe that the longest string is on the left-hand side, not the right as in his drawing. The top block slopes at an angle of 45°."



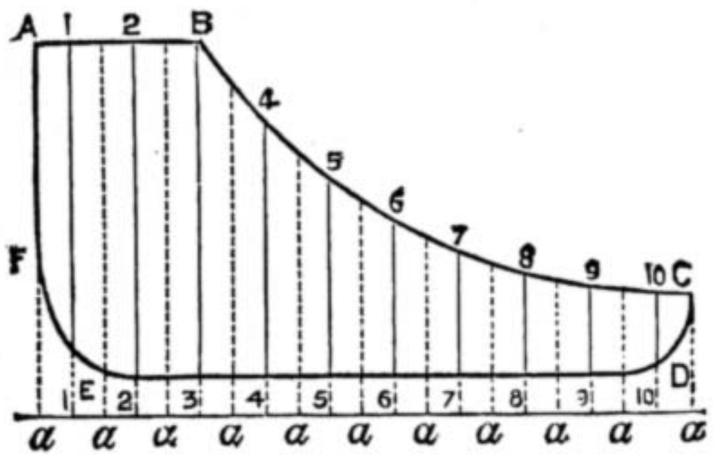
Prince of Wales' Harp.

II.—Questions Answered by Editor and Staff.

Fret Pattern.—M. G. (*Glasgow*).—Before I can answer your question, where you can get a fret pattern such as you want, I must ask what you mean by the "Freemason's coat of arms." If you do not quite know what you mean, let me advise you to ask some mason to take you into a lodge. When you have sat in one, you will be able to explain as fully as you desire to, and I, or any other mason, will, as a brother, respond equally fully and explicitly. Meanwhile I may say that it is, to say the least, very improbable that you will get anything indicative of masonry in fretwork.—D. A.

Electric Lighting of Workshop.—M. R. (*Burnley*).—When you have read my forthcoming articles on "Model Electric Lights," I think you will not seek to light your workshop with electric light maintained by a battery. I need say no more here. A coil is useless for the purpose.—G. E. B.

Horse-Power of Engine.—J. H. S. (*St. George's East*).—To find the indicated horse-power of a steam engine, we must have an indicator diagram, which will be of a form similar to that shown in the accompanying sketch. The line A B C D E F A is drawn by the indicator pencil, and the height to which it rises shows the pressure per square inch (to a given scale) at every part of the stroke; the length of the line *a a* is proportional to the stroke; the paper upon which the diagram is made being drawn round on a barrel by attaching to it a card connected with some moving part of the engine, so that the paper moves horizontally in a certain proportion to the travel of the piston, while the indicator pencil marks the pressure at every point. The diagram shown is for a non-condensing engine, and the indicator piston spring indicates one pound per square inch for every 50th of an inch above the atmosphere line *a a*, on which the pencil rests when out of use. There is a back pressure shown by the height of line D E above *a a*. The effective pressure at any point is represented by a vertical line ending top and bottom at the boundaries of the diagram. To find the mean pressure of steam for the whole stroke, proceed as follows:—Divide the length of the diagram into any number of equal parts—say, then, as shown by dotted lines drawn up from *a a a*, etc.; then lines drawn up the centres of these parts, 1, 1—2, 2,



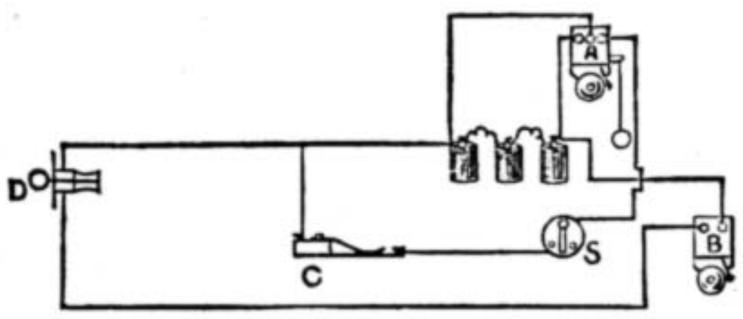
Engine Indicator.

etc., will be the mean pressure for each part, and all these mean pressures added together and divided by their number will be the mean pressure for the stroke; thus, take a scale of inches divided into fifty and apply to the diagram, we then find the lengths to represent:—

1-1	= 45	lbs.
2-2	= 52	,,
3-B	= 52	,,
4-4	= 40	,,
5-5	= 31	,,
6-6	= 25	,,
7-7	= 19	,,
8-8	= 16	,,
9-9	= 14	,,
10-10	= 11	,,
Total	305	,,

The total, 305, divided by 10, the number of measurements, gives 30½ lbs. per square in. as mean pressure. The area of the piston multiplied by this gives the total pressure on the piston. The area of a circle is equal to its diameter squared, multiplied by 11, and divided by 14; but you can get it from a table of areas. Suppose the piston to be 16 in. in diameter: 16 multiplied by 16 is 256; this multiplied by 11 is 2,816, which divided by 14 gives 201 square inches area of piston. Total mean pressure on piston, 201, multiplied by 30½ lbs., equals 6,130½ lbs. Let the stroke of the piston be 2 ft. 6 in., and the engine make 60 revolutions per minute—that is, at 2 strokes a revolution, 120 strokes a minute—the piston therefore moves 120 multiplied by 2½ ft., which equals 300 ft. per minute. The steam therefore in each minute does work equal to 6,130½ lbs. through 300 ft.—that is, 1,839,000 ft. lbs. per minute. A horse is assumed to do 33,000 ft. lbs. of work per minute; therefore, dividing the work of the engine by that of a horse in the same time, or 1,839,000 ft. lbs. by 33,000 ft. lbs., we find the indicated horse-power in our example to be 55¾. The rule put compactly is:—To find the indicated horse-power, multiply the area of piston in square inches by the mean pressure of steam in lbs. per square in.; multiply the product by the length of stroke in ft., and by the number of strokes per minute, and divide by 33,000.—F. C.

Ringing Two Bells with One Battery.—GODIVA.—Connect up your two bells to the battery as shown in the annexed sketch. In this we will call B the door bell. Lead one wire direct from this to the front door pull D. From the pull lead a wire to the zinc of battery; then from the carbon of battery lead a wire to the free terminal of bell B. This will complete the circuit of one bell. Now for the alarum bell A. Lead wires from the two terminals of the battery to the continuous ringing



Mode of Connecting Two Bells to One Battery—A, Alarum Bell; B, Door Bell; C, Contact; D, Door Pull; S, Switch.

arrangement terminals of the bell. Of course this will not ring when the lever is up. Connect one part of the burglar contact C by a piece of wire with the line wire of the pull leading to battery. Connect the other to the switch S, then from the switch to the free terminal of the bell A. At night, when you pull over the switch, the alarum bell will start ringing if the burglar alarum is also in contact. In the daytime, when the switch is off, and the lever on the bell up, it will not ring. By this arrangement the two bells may be rung from one battery without interfering with each other.—G. E. B.

Fire Forge.—W. R. (*St. Day*).—It will require a separate paper to do justice to this subject.—W. P.

Index to WORK.—E. J. A. (*Chorley*).—An Index is published with the yearly volume of WORK.

Spring Mattress.—PATRAS.—I am sorry that instructions for making this cannot be given in the "Shop" columns, as at least two pages of space would be required. You and other inquirers must therefore be good enough to wait till an article on spring mattress making can appear. The number of springs varies according to circumstances.—D. A.

Fret, Polishing, etc.—ARTISAN.—Do you really expect to find combined in one machine all the best qualities of those specially constructed for thick and thin wood? If so, I am afraid you will be disappointed. I do not know of any machine which is equally good for ¼ in. and 3 in. stuff, but by getting a Britannia Co.'s No. 8 you may cut anything up to 1 in., and for larger sizes the fret appliance for working with their circular saw is as good as any. Size of saw blades, of course, depends on work to be done. The small fret saws are freely advertised at about 2d. per dozen. Get an assortment. The larger saws for big work (bow saws) are about 1d. per inch. Your questions on polishing are far too comprehensive to be answered fully in "Shop." Fumigation is managed by enclosing the wood to be darkened in an air-tight box or room with some strong liquid ammonia. I have never noticed that "polish soon gets rotten on furniture stained in the prevailing dark shades," so cannot assist you. As stains do not contain anything injurious to polish, if they are such as usually used by polishers, I am inclined to think that you have originated a fanciful complaint If any stain produces a bad result, try another. Any of those which have been recommended in these columns may be used with perfect safety. I do not care to recommend the filter you inquire about, but that is far from saying it is bad. Many people speak highly of it, and I only give my own opinion. Try it for yourself, and note the cost. On sand-papering machines, and machinery required in a small shop, little can be said here, for how on earth can I know your requirements? You know what you want to do, so get the articles as opportunity presents itself. For a small shop where all sorts of odds and ends are made, I do not consider machinery a saving. It seems to me you want to fit up a small shop with machinery to do everything on a small scale. If so, it won't pay.—D. A.

Telephones.—CLERICUS.—It is very difficult to give advice in telephone matters, for the simple reason that it is almost impossible to construct a set of apparatus that will not in some way be an infringement upon the United Telephone Co.'s patents. There have been no end of instruments devised by practical men, and companies started to make and sell these instruments to the public, and in almost every instance the result has been a law case, and the United Telephone Co. placed in the position of—to use a vulgarism—"the cock of the walk." When I wrote the article on the speaking telephone, I only described such apparatus as could be used experimentally. I did not wish to place amateurs, or any one who followed my instructions, in an awkward position. For we cannot make and use for our convenience, as far as I know, any set of telephonic apparatus, consisting of magnetic receiver and carbon transmitter, without, as I have already said, infringing upon the United Telephone Co.'s rights. However, with regard to your difficulties, I will answer your last question first. Use the form of microphone described in my paper, No. 28 of WORK, and given as Fig. 1 in your own sketch. It is easily made, and answers most admirably for experiments. The stand is made of wood, and the wires are connected to the carbons by simply lapping them tightly round. If you are well up in electrical matters, you could deposit a coating of copper in the ends of the carbons and solder the wires to them; this is the most workmanlike method, but the other will answer your purpose well enough. The carbon blocks may be fastened to the upright piece of wood by boring a hole in the carbon block about half way through, and passing a common screw nail through the wood into the hole, or they may be fixed with melted shellac or sealing wax. You seem to be a little hazy about the connections, and have jumbled up "line" and "earth" and battery wires most hopelessly. The "line," of course, means the connection between the two instruments; the "earth" wire means a wire in communication with the earth, to save the trouble of a return wire. If you make a set of apparatus, you will require a transmitter, a receiver, and a battery at each end, and your connections for each will be the same. I have shown these at Fig. 1. A complete set of apparatus for two stations consists of receiver, transmitter, indicator, call bell, and battery. These, with the exception of the battery, are generally mounted on a board called a switch board, which is made to work automatically, so that either piece of apparatus is switched in or out of circuit as required, and these are connected with a single "line" wire. I may just whisper to you that after a while I am going to give the description of a set of apparatus, original, although but modifications of existing instruments, easy to make and reliable. This, of course, cannot be given in "Shop," so you can work away with what information you have got in the meantime.—W. D.

Covering for Wire.—P. K. (*Birmingham*).—Cover with soft spun silk or with soft cotton. Inquire of any silk mercer in a fairly large way of business, and tell him what you want it for. It is several years since I bought any, as I find that it does not pay me to cover my own wire, as those in the business can do it cheaper and better.—G. E. B.

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Preparing Bird Skins.—J. H. F. (*Manchester*).—The wire system is far the best for preparing bird skins, for the following reasons:—(1) On account of quickness in finishing the specimens. (2) You can pack the birds in less space until dry. (3) It would be almost impossible to fix the birds in a natural position, on account of the birds being put in boxes and partly covered over with bran, and you would be unable to watch the bird dry unless you took it out every day, which would mean disarranging the feathers. (4) Waterton's method is impracticable to any one but those who can spare unlimited time over one specimen.—J. A. W.

Camera Dimensions.—E. J. P. (*Hockley*).—"Half plate" size is 6½ in. by 4¾ in., which is more than the half of whole plate. To construct a camera for this size plate the focussing screen must be 6½ in. square, and the length of bellows about 10 in. or 12 in. The back of camera must be made to suit the focussing frame, and the woodwork rather lighter: in fact, the size of the focussing screen regulates the size of the rest of the apparatus. The dark slides may be made as substantial as for whole plate, but to hold the smaller plate.—D.

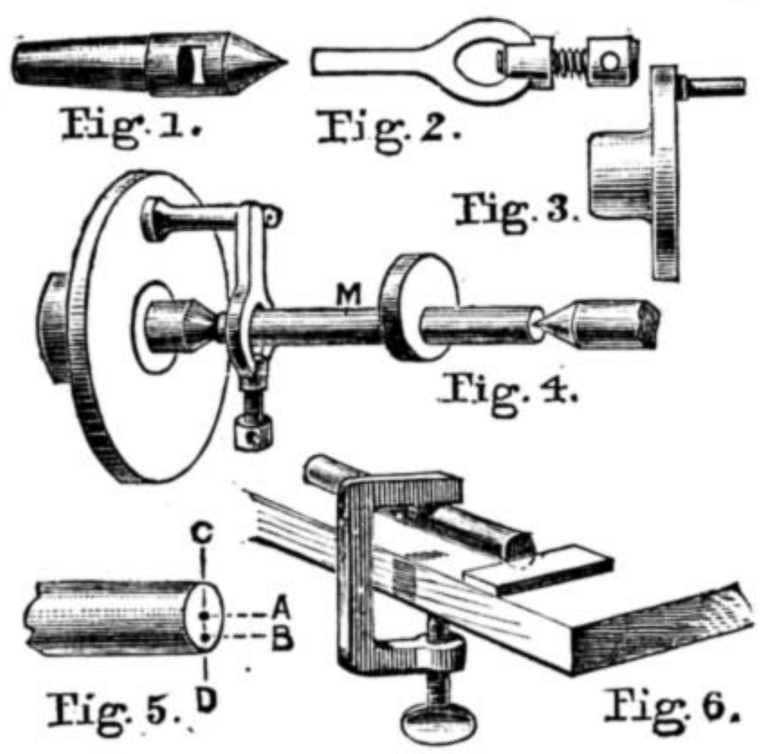
Roller Slide.—P. W. (*Bradford*).—In making the slide referred to, the principal points are to have the film or paper evenly stretched on the same plane, which is effected by a tension spring and rollers. The space in which they work is determined by the kind of film or paper used. The thinner the material the less the space, and *vice versâ*. To give a detailed description would occupy some pages of this journal, and impossible in these columns. Obtain one of the more recent forms of this kind of slide, and look it over carefully.—D.

Reversible Spring.—BEWILDERED ONE.—This question is impossible to answer as it is put, as the querist does not give enough particulars. He is doubtless aware that a spring will not give out anything like the power that is put into it, therefore it is difficult to see how, when the spring is wound up, it can unwind without pause at the same speed, and make the same number of turns with the same power. The nearest approach I can at present remember is in the drill stock used by china riveters and others, which has a loaded spindle (acting as a fly-wheel), and two cords affixed to spindle so arranged as to turn contrariwise, one cord unwinding as the other is coiled upon the spindle; an alternate rotary motion of, say, eight or ten revolutions is thus secured; the operator supplies the power by working a handle attached to the cords. No *single* coiled wire spring can be reversible, but a pendulum spring like a harmonium reed is so, and the hair-spring of a watch *with a balance wheel* is practically so. No doubt, if further particulars were given, useful assistance could be given by B. A. B.

Chime Clock Parts.—F. H. (*Streatham*).—The number of wheels in a chime quarter clock are as follows:—The going part, great wheel, centre wheel, third wheel, 'scape wheel, with centre, third, and 'scape pinions; the number of teeth in the wheels and leaves in the pinions depend upon the length of pendulum: if a seconds, then have the great wheel, 96; centre, 64; third, 60; 'scape, 30; pinions, all 8. Hour striking: great wheel, 84; pin wheel, 64; pallet wheel, 70; warning wheel, 60; pin wheel pinion, 8; pallet wheel, 8; warning and fly pinions, 7, with 8 pins in the pin wheel. Quarter chiming: great wheel, 100; second wheel, 80; pallet wheel, 64; warning wheel, 50; wheel on chime barrel, 40; all pinions, 8. Hour striking and going barrels about 2½ in. diameter; quarter, a trifle larger, say ½ in. Motion work on the wheels that carry the hands may be 2, with 40, and hour wheel, 84; minute pinion, 7. The moon may be driven by putting a pinion, say, of 40 on the hour wheel socket with a wheel of 80 working in it, on which put a stud that shall drive a large wheel of 59, on which paint two full moons; this last large wheel is generally mounted on a stud or screw in the top of dial, and has saw-like teeth, the stud or pin in the wheel of 80 just catching in it and moving one tooth at a time. Fuller descriptions and drawings of a quarter clock may be seen in Britten's "Watch and Clockmaker's Handbook," a very useful publication, and should be in every amateur's hands. All the wheels, pinions, and every requisite for the above, may be got from Grimshaw & Co., 35, Goswell Road, Clerkenwell, London, or J. Mayes, 55, Red Lion Street, Clerkenwell, who make a special line of clock materials, and I can highly recommend them.—A. B. C.

Varnish for Bicycles.—W. B. (*Huddersfield*).—Silica enamel is a transparent varnish, used for covering bright parts and nickel plating to prevent rust. It may be got in 1s. bottles from any of the cycle dealers. It is applied with a brush which is supplied with the bottle. The best thing for nickel plated parts when the machine is to be put past for a season is to coat them with ordinary glycerine or vaseline paste.—A. S. A.

Turning Eccentrics, Fly-wheels, etc.—J. W. R. (*Cockermouth*).—There is an article in the Editor's hands on "How to Make a ¼-Horse-Power Steam Engine," with full-size working drawings of all the parts, and sketches showing how to chuck the different eccentrics, etc. etc. It contains the information you appear to be in search of. As I do not know how long it may be before it appears, I will give you a few hints to go on with. You have a lathe with "back-gear and a face-plate, but nothing else for metal turning," and you want to make model engines. You will require besides the face-plate a pair of "centres," a "carrier," and a "catch-plate" or "driver" chuck. Figs. 1, 2, 3, show these three requirements. Fig. 4 shows the eccentric in position for turning its sides (and its boss, if it has one). You see from this sketch how the centres, driver, and carrier are used. M is a rod of steel called a mandrel, centred and turned so that it will fit tightly into the hole you bore straight through the eccentric casting; the carrier being screwed on one end of this mandrel, the arm of the driver chuck will catch it and drive it round. Thus arranged, you can turn one side of the eccentric true with the hole; then drive it off the mandrel, turn it round, and drive it on the opposite way to turn the other side. Now you require to turn a flat groove in the edge, and to do this it must be rechucked, so that the body will run true and the hole eccentrically. One way to do this would be to make two other centre marks or holes at the ends of the mandrel. Fig. 5 shows one end of the mandrel so centred, A being the first and B the second centre upon a line C D, which must be parallel with a similar line containing the two centres at the other end of the mandrel; this is easily ensured by clamping the mandrel down upon a flat board or face-plate, then providing a bit of parallel wood or metal of a thickness equal to half the diameter of the mandrel. Fig. 6 will show this at a glance, and how the line joining the two centres could be scribed along A B, and then the bit of wood moved to the other end of



Eccentrics, Carriers, etc.

the mandrel and a similar line marked there while the mandrel remains fixed. Evidently the distance A B between the two centres is the throw of the eccentric (equal to half the stroke of the valve), and if this method is to be adopted, that distance must be less than half the diameter of the hole through the eccentric. This mandrel so prepared will serve for any number of eccentrics of the same size. Another way to chuck the eccentric to turn the outer groove, would be to fit a small brass chuck to the lathe, and, having surfaced the front of it quite flat, tin it, and tin one side of the eccentric; then having carefully fixed and wired the eccentric upon it in the correct position, heat the two till the solder melts and unites them. Many other ways might be named; it depends partly on the work and partly on the workman which will be the best. Having chucked the eccentric, turn the groove to fit one of the half-straps, which must have been bored out before the eccentric itself was undertaken. In all such work as this, where there is a central hole of any size, it is best to begin with the hole; finish that first, true and smooth, then chuck the piece by the hole by driving it on a mandrel; this ensures that the rest of the work will be true with the hole. In a fly-wheel, however, the hole is too small to take a mandrel large enough to hold the wheel firmly; it will be better then to hold the wheel to the face-plate by three of its arms, by means of screws or bolts passing through to the back of the plate, and putting a little bit of wood under each of the three arms to take the pressure, and hold the wheel off the plate; or you might screw a piece of board to the face-plate, turn out a recess, and drive the casting into that recess to hold it. Now proceed to turn the projecting part of the rim, then the boss, and very carefully bore the hole. A common drill can hardly be depended upon to do this truly; a half-round, or D bit, will do it, so that when the wheel comes to be mounted on the shaft it will run true. The wheel will then be unchucked by taking it out of the recess, a fresh recess turned to fit the turned edge, and the wheel pressed into it to turn the other side and the remainder of the rim. For making model engines you will want a set of drills, and an American "Universal," say 3 in. or 3½ in., will be extremely useful.—F. A. M.

Soldering Bronzed Ornaments.—J. H. B. (*Stratford*).—You ought not to have any difficulty about this. I myself have frequently to repair this kind of thing, and have never had the least trouble. You must scrape the bronze or lacquer off a little each side of the joint, and use clean raw spirits and a fairly hot iron, so as to melt the zinc a little and cause it to unite firmly to the solder. Use a very little solder at a time, trim off with a file and scraper, and then touch up as follows: pound a small piece of sulphate of copper (bluestone), dip a brush in your killed spirits, and dip this brush in the powdered bluestone, and apply to the parts soldered.—R. A.

Starch Gum.—J. R. O. (*Mitford*).—The adhesive matter used on postage stamps is, we believe, dextrine, or starch gum. Starch is converted into gum by certain acids, by diastase, or by heat. What is known as "British gum" is said to be converted at a high temperature, 600° or 700°. To this, probably, the bad colour of which our correspondent complains may be owing, though we question whether it would be improved by his beer and sugar.—S. W.

Giving to Plaster the Appearance of Ivory.—J. R. O. (*Mitford*).—Various matters have been used for the saturation of the plaster; to gain something of this appearance, that most commonly employed is wax. Melt white wax in a vessel deep enough to "bath" the cast; the latter, which must be thoroughly dry from casting, must be heated, and then laid in the melted wax. As soon as the wax rises to the surface the saturation will be complete, and the cast must be removed.—M. M.

Malleable Iron Castings.—PERCY FIRTH.—Malleable iron castings are moulded in green or in dried sand like ordinary castings. But they must be poured with white or with mottled iron in which the carbon is wholly, or almost wholly, in the combined condition. Grey iron, in which the carbon is in the graphitical condition, is not used. The iron being white or mottled, the runners must be of the flat thin type, rather than round, so that when broken off they will not leave unsightly depressions on the castings, or tend to draw and break them. Hematite pig from Cumberland is employed; and for small castings, Moxeley sand from Birmingham. After the castings are fettled they are put into annealing pots: preferably cylinders of cast iron with covers, similar to the cast-iron pots commonly used for case hardening. In these the castings are embedded in layers of red hematite ore, ground, and passed through a riddle of about an eighth of an inch mesh. Or iron scale, free from dirt, is alternatively employed. The thickness of the intervening layers of hematite or scale may be ½ in. or more, dependent upon the bulk of the castings. All the castings in a single pot should be as nearly as possible of the same size; if of different sizes they will be unequally decarbonised. The pots are heated to a bright red, and kept at that temperature for sixty or eighty hours, according to the size of the articles, after which they are allowed to cool down gradually for about thirty hours in the furnace, then taken out, and when quite cool are emptied of their contents. You will find it much cheaper to buy your castings than to make them.—J.

Castings of Cylinder, etc.—F. H. H.—Can you not get a local pattern-maker to make them for you? If not, ask the Editor for my address, and I will give you a price. There is no book worth having on *model* steam engines. But if you mean working engines, there are plenty: Bourne, Sennett, Seaton, Forney, and others advertised in the publishers' catalogues. Oak stain, American potash, 2 oz.; pearlash, 2 oz.; water, 1 quart. There are plenty of good petunk machines which you might copy without requiring a description, and which you could purchase for less than they would cost you to make. The Britannia Company, of Colchester, can give you choice of several excellent machines at moderate prices.—J.

Electric Bell Fittings.—S. (*Reading*).—To connect your front gate with an electric bell in the house, you will require an electric bell pull (cost from 4s. 6d.) let into the gate post; 400 ft. of No. 20 gutta-percha covered copper wire (cost about 9s. 6d.); a 3 in. electric bell (cost from 6s. 6d.); four cells No. 2 Leclanché battery (cost 8s.), and about 2s. worth of No. 20 cotton wire for indoor use. Total cost not less than 30s. for material. By using No. 18 wire at an extra cost of 5s., you may work your bell with one cell less. Bunsen batteries are altogether unsuitable for bell work. If you can locate the battery in a cellar or similar cool place, that will be the best spot for it. Shall be pleased to advise you further if you need advice.—G. E. B.

Conversion to Lathe.—THREE LEGS.—I do not advise you to try to improve your sewing machine; but as for the treadle and stand, you may make that useful in other ways. No doubt Mrs. J. M. seldom requires the lower part, preferring for short work to turn by hand. You can therefore utilise the treadle and stand for a *small* lathe or fret saw. Mind, it must be a small one—say, about 2½ in. centre; the treadle and fly-wheel will not give you power to work anything large, and your feet and legs will soon get cramped if you do that work for long. Still, a very small lathe, to be removable at pleasure, and to which you could sit to turn chess-men, draughts, pen-holders, tool-handles, and make small screws and pins of metal, etc., would be very useful, even if you had a larger lathe by-and-by, and would be a very interesting thing to fit up. Perhaps you might meet with a clockmaker's lathe, second-hand, that would suit you.—F. A. M.

Enamel Painted Furniture.—F. J. S. (*Birmingham*).—This can hardly be said to be the work of a French polisher, painted work being generally a branch by itself. Still, as polishers have many ticklish jobs pass through their hands at times, and you seem to have tried to succeed, I will gladly help you as far as I can. You do not say whether

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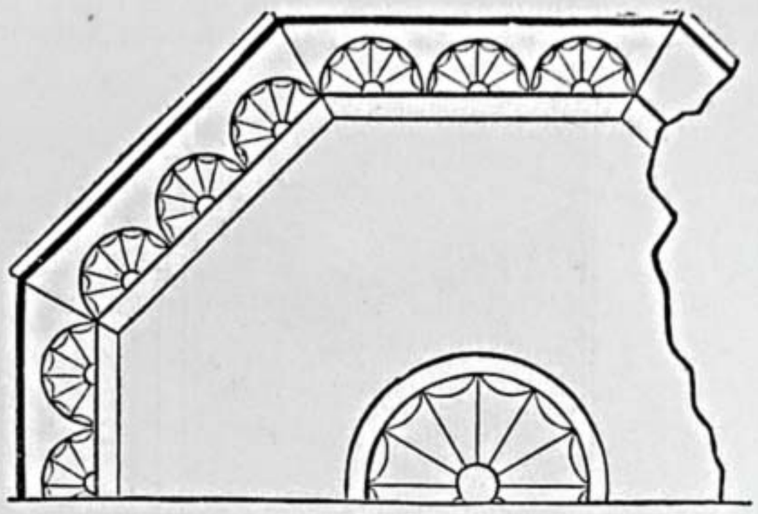
you have made your own enamel paint: whether it was mixed with spirits or turps. The mistake seems chiefly to have been in using enamel paint instead of enamel varnish. The latter should give a resultant gloss, that should not need the application of white polish to finish it as you seem to surmise. I have generally met with satisfactory results by using a white spirit enamel, and the plan I sometimes adopt—though not the one followed out by enamel painters—is as follows:—First size over with clear patent or Young's size, to which has been added some finely-crushed dry whiting, to prevent suction; when dry, glass-paper quite smooth; then give as many coats of spirit enamel as may seem desirable—generally five or six, allowing a sufficient time to elapse between each coat—using a little worn glass-paper if necessary, but preferably levelling each coat by means of a perfectly flat rubber of white polish, used rather thin. It requires a little tact and judgment to well level varnish by means of a polish rubber; the happy knack lies in knowing just when to leave off, and when to apply the next coat of varnish; experience alone will teach this. To make spirit enamel:—Mix finely-crushed flake white with white or transparent spirit varnish. This should be thoroughly well mixed, the flake white being added till the whole looks pure white. It should then be well strained through muslin and thinned with spirits, if necessary, before using. A suitable spirit varnish can be made by 1 pint rectified naphtha, ¼ lb. white shellac, 2 oz. gum sandarac, 1½ oz. gum benzoin, ½ oz. clear resin; the gums to be finely crushed and dried before using. Dissolve by gentle heat and well strain. Of course, if you can get transparent varnish, so much the better. It is better that this latter should be bought at a respectable gum merchant's or varnish maker's. The process of purifying through charcoal is, to say the least, tedious; it is quoted by a well-known London maker at 12s. per gallon, whereas, white hard varnish is 7s. per gallon. You say white polish is not transparent, and gives a dirty appearance. This ought not to be the case; perhaps the shellac was dirty, or too much heat used in dissolving. It is almost best that transparent polish be bought ready made, still, it may be useful to know how it is made. Transparent polish:—Take 3 oz. clean white shellac, ½ oz. clean benzoin, 1 oz. juniper, 1 pint methylated spirits; dissolve well by means of gentle heat. When cold, pour off carefully all the clear, then warm again and thoroughly strain. It may be well to state that most japanners for a white ground use copal varnish and zinc, or flake white; they seldom make their own, preferring to buy direct from the varnish maker. Another plan, and one generally adopted, is to use the enamel paint as you have done, only instead of finishing by means of French polish, they finish by the application of one or two coats of enamel varnish, made of the best, or preferably, colourless copal varnish and flake white. For large flat surfaces, these varnishes are best applied by means of brushes such as painters use rather than camel hair. Should this varnish be of first-class quality, it will give that hard porcelain surface which you so much admire. You will notice that in white enamel the colour is recommended to be used throughout; in tinted or coloured enamels this is not necessary. The finishing coats may be of clear varnish.—W. J. M.

Edco Battery.—ELECTRIC LIGHT.—(*Leytonstone*).—I have not had any experience with the Edco battery, but have had to do with batteries of similar construction, and my experience is similar to your own. In my articles on "Model Electric Lights," I shall give directions for making electric light batteries.—G. E. B.

Delay in Replies.—CLERICUS SECUNDUS.—You and other readers complain of the delay in getting replies to your queries. The pressure upon the "Shop" columns of WORK since the commencement of the magazine has been such that had the whole sixteen pages weekly been devoted to correspondence there would have been an excess of matter. Arrangements are under contemplation for dealing with this demand upon our space, and of bringing answers closer to date.—ED.

Renovating Chairs.—A. M. (*Maida Hill*).—Unless the leather is very much worn, it is generally possible to improve its appearance. To do so, however, requires a considerable amount of care, and the risk of further spoiling the leather is not small. The best material to use for the purpose is thin French polish, applied with a soft rubber. Be careful not to saturate the leather, but just go lightly over it with a moistened rubber. The polish may be coloured if necessary to match the leather, but it is not generally necessary. White of egg has sometimes been recommended as a substitute for polish, but I have no personal experience of its use, and merely name it in case it should be more convenient if you like to try the experiment. I cannot agree with you about the advisability of giving costs of materials used in the construction of any article described in WORK. Where there is likely to be any difficulty in obtaining out-of-the-way things, names of suppliers are often given, and this ought to be enough. Any would-be maker can generally find out for himself the cost of materials in his own neighbourhood. Locality you must know has often a great deal to do with price of raw material, and what is applicable to London would be wrong at, say, John o' Groats or the Land's End. WORK does not pretend to remove all trouble from the shoulders of workers, and something must be left for them to do. It only assumes to suggest, direct, and advise those who take advantage of its friendly counsels. Papers on the subject you name will appear as soon as practicable. There are so many subjects to be treated that it would be unfair to devote too much space to any one of them. Perhaps you will kindly explain this to your anxious friends, and assure them that their wants will not be overlooked.—D. D.

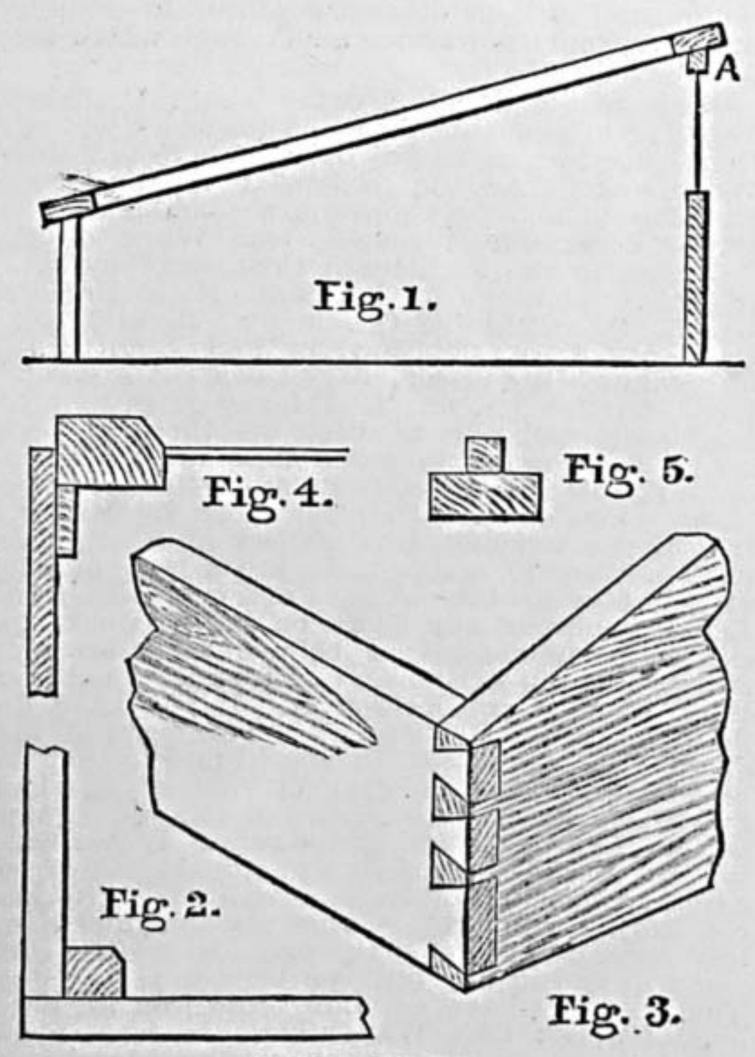
Inlaying Top.—DRAPER (*Lawrencekirk*).—Such an immense variety of inlays would be suitable for your table that you can hardly go wrong in adapting any design you like. As a suggestion for a simple one, this illustration may help you.



Inlay for Table.

The different pieces are to be shaded by the hot sand process. In the centre put an inlay of similar style, but circular instead of semicircular, like those nearer the edge. Various stringings can also be inlaid.—D. A.

Garden Frame.—C. H. L. B. (*South Shields*).—There are so many varieties of design and make in the way of garden frames that it is rather difficult to give you an idea of one without knowing exactly your particular requirements. I give you, however, a few diagrams that may be of help, as, if they do not quite suit, they may at least give you an idea how to proceed, and you can modify the details in accordance with your wants. If you want a good substantial piece of work, use 1 in. boards for the front, back, and ends, and make your frame after the style of Fig. 1, which is a cross section. The woodwork of the back is the same height as that of the front, and the upper



Garden Frame.

part is filled in with glass. If you make a short frame, say about 5 ft., you must put a rail along the top of the back, about 2 in. square (A, Fig. 1). If your frame is longer, then divide it into equal parts and make two or three top sashes instead of one, as they will be easier handled. The sashes are best made to slide. Fig. 4 shows how to put the fillet on the ends for this purpose, and Fig. 5 is a section of the intermediate sash bearers; these bearers must have an upright support at the upper end to carry the weight of the glass of the back. You can either dovetail the sides and ends of the frame, as in Fig. 3, or put it together with 2 in. corner posts, as in Fig. 2; the latter is much the easiest, and will serve all practical purposes. I do not know if you can make the sliding sashes, but if not, you will have a paper in WORK shortly that will give you full and detailed instructions. Necessarily, this is but a brief description, but I hope you may get an idea out of it that will enable you to construct your frames to your satisfaction; if not, write again, and say more explicitly what you do want.—G. LE B.

Upholstery.—A STUFFER.—Your previous letter was duly answered, but, owing to the increasing number of "Shop" inquiries, it has had to wait its turn. You will see it before this meets your eye. The branch of upholstery to which you refer will not be omitted, but it is such an extensive one that the articles on it will have to be suggestive rather than comprehensive.—D. D.

Mahogany Stain.—E. B. (*Derby*).—For a good mahogany stain which will strike well into the grain of pine and not merely lie on the surface like paint, use a little Bismarck brown added to the vandyke brown stain instead of burnt sienna. Dissolve the Bismarck in a little spirit and then mix it with the other. Remember that as Bismarck brown is a very powerful colour, you must not use too much of it. Excess of it will give a fiery red colour, which, whatever it may be, is not mahogany colour.—D. A.

Book on Wood Carving.—E. L. R. (*Oxford*).—There are several handbooks of a more or less elementary character, but I do not know of any in which you will find it "explained in all its branches." Perhaps the best for your purpose is Eleanor Rowe's "Hints on Wood Carving," 1s., obtainable at the School of Art Wood Carving, City and Guilds Institute, Exhibition Road, South Kensington. You will find much valuable information on wood carving both in the "Shop" and general columns of this magazine.—D. D.

Toy Making and Varnish.—D. McD. (*Paisley*).—I am afraid your question borders so closely on the frivolous that it need hardly have been put. If you have "nous" enough to make the whistles and arrows, surely, as you have the patterns before you, you can devise modes of working them better than we—who have not seen the particular articles—can possibly do. Probably a spirit varnish has been used; but this you can easily ascertain by taking the things to some dealer, or, better still, manufacturer of varnish. Really, if one may judge from your letter, the acumen with which "Paisley bodies" are credited must be on the wane.—D. D.

French Polishing.—W. G. (*Exeter*).—Messrs. Wyman & Sons, Great Queen Street, London, W.C., publish "A Practical Guide to French Polishing" at 2s. 6d., but you will probably find the references to any articles on the subject in this Magazine of much more service to you. My advice is, study the "Shop" columns weekly, and you will gather a store of hints which you will not be able to get elsewhere.—D. D.

Bamboo Cabinet.—R. J. L. (*Salisbury*).—No, your previous inquiries were not overlooked. A reply was written without loss of time, and will, no doubt, have appeared in "Shop" ere this meets your eye. The only cause of delay is the extreme pressure for space on this part of the Magazine. It is impossible to say exactly when the next article on bamboo work will appear, as so many subjects have to be treated. Some very good things will, however, be given as soon as the time for their publication arrives.—D. A.

Taking out a Patent.—J. W. B. (*Birkdale*).—It will always be uncertain whether any invention, however valuable it may appear to be, will take with the public, and we cannot assume the responsibility of advising J. W. B. either to patent or otherwise. To us his invention appears a useful one, and we see no reason why it should not be brought into general use, but he must himself decide whether he is inclined to incur any risk with regard to it. Should he decide to do so, he should obtain provisional protection; he can then safely show a model of the article to influential firms in the business to which it applies, and from their reception of it judge whether he will or will not be justified in completing his patent. He should not show his invention till he has secured his provisional protection.—C. C. C.

Whitewashing Ceilings.—NEW SUB. (*Banbury*).—A full and complete answer has been published since you wrote, viz., the paper on "Distempering," at the end of Vol. I. The only way to get "snowy white" ceilings is to first wash off the dirty old stuff with brush and water, and when dry coat with jellied distemper, which has been slightly tinted to a grey with *lime blue* powder. When dry this assumes the above appearance, and whiter than the unstained whiting and size would be. You can coat over ceilings which are not very dirty once or twice with a *thin* coat of white, but after that they will require washing off down to the plaster, otherwise the accumulated coats will crack and peel off.—F. P.

Upholstery Work.—J. A. S. (*Nottingham*).—Undoubtedly upholstery work, both plain and fancy, will be treated in due course.—D. A.

Polishing Oak Seats.—LIGHT OAK (*London, S.W.*).—Your best plan will be to clean up the seats and parts on which the polish is defective, and then repolish as if the work was new. Use a scraper to remove the present polish. It depends on the depth to which the stains have penetrated how much you must scrape. If you find that the stains are in the polish only, you will probably be able to dispense with filling. As you do not wish to study the whole subject, I cannot do better than refer you to the answers on polishing, which have been given in back numbers of WORK. If you

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do not find what you want to know in them, write again, stating the point on which you desire instruction.—D. D.

Wire Thread Fret Saw.—A. B. C. (*Houndsditch*).—Personally I cannot see that for ordinary work these have any advantages over the usual blades. Owing to the claims set forth on their behalf, I gave them a trial. They did not commend themselves to me. You will have noticed that they have been commented on in the Editorial "Guide to Good Things." Why not get a dozen or two and try them for yourself?—D. A.

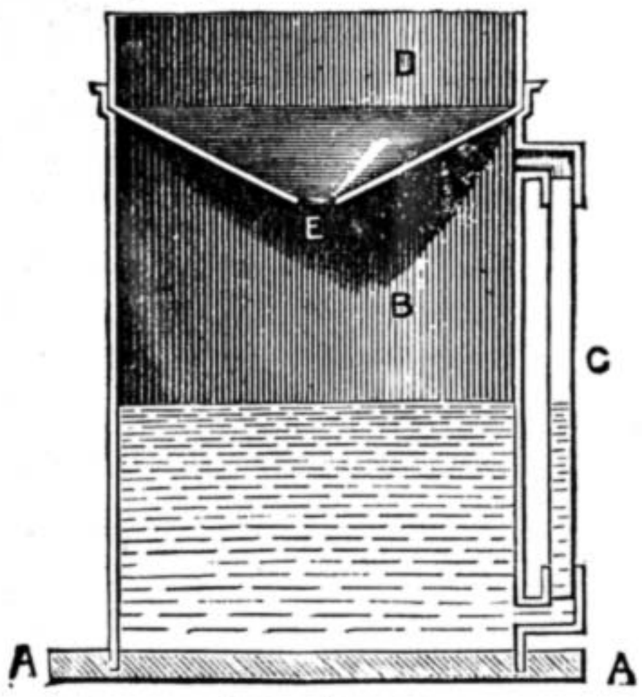
Secretaire Dimensions.—W. H. T (*Stretford*). Yes, a paper on the construction of a davenport will be given in course of time, but it must wait, as writing arrangements have had a good share of attention in WORK. The sizes you name are altogether too large for a davenport, which at the outside rarely measures more than 2 ft. from back to front and across front. Generally they are even smaller. The height of writing slope you can easily arrive at for yourself, but as a rule it is rather less than greater than that of an ordinary dining-table. "Secretaire" is only a general term for almost any kind of writing-table or desk, and is too vague to indicate any special piece of furniture. Thus, davenports, cylinder and register desks, and a whole host of fancy arrangements, such as the screen secretaire, to which an article was devoted a few months ago, are all classed as secretaires. If you tell us the particular sort of thing you have a fancy for, I will, if possible, give you such details in "Shop" as may help you. Would not the bureau, such as has been described, suit you? It might be made small.—D. A.

Colouring Photographs.—P. P. C. (*Dudley*).—(1) Your question how to colour photographs and fix them to a folding screen was not easy to answer. I purposely interviewed one of the chief dealers in London to obtain address for the makers of colours, presuming that special ones were employed. But so far as he knew ordinary water colours mixed with a little gum were always used. The difficulty in applying these was overcome by—forgive the vulgarity, he blushed when he whispered it, I blush as I write it—licking the print over with one's own tongue. After this painful operation, the water colour will be found to work well; of course, in bromide or platinum prints the preliminary process may be foregone. While not recommending Judson's penny packets of dyes, which afford transparent stains, I should feel inclined to try them for washes in skies or large masses of foliage. There are clear liquid colours sold for map-tinting by all artist's colourmen. (2) To use coloured photographs as decoration for a folding screen seems full of practical difficulties. First, the prints must be coloured after they are stuck on, for there is surely no way to mount a photo. That dispenses with both surfaces being thoroughly damped, and soaking a water colour is not considered advantageous. But even granting that the awkward plan of colouring photographs after they are mounted does not deter you, I can hardly suggest any mount that would stand the strain. It is possible that well-strained canvas — papered with more than usual care, and extra thick paper—might do, but short of an actual trial we could not advise it. A series of papers on screen-making and decoration are in preparation; the subject is constantly being approached by subscribers, who will then find the full details required.—E. B. S.

Coach Painting and Building Books.—CREST (*Oldham*).—There is a "Handbook for Coach Painters," edited by G. A. Thrupp, price 1s., by post, 1s. 3d., to be had of Cooper Bros. & Attwood. Long Acre, London, W.C. Another book, called "Coach Painting," by Arlot, price 6s., can be had of Spon & Co., 125, Strand, London. There is another book which is at present in the press, and will be entitled "Boag's Guide to Coach Painting," by A. Boag. The price, *if ordered before publication*, is 10s. 6d. If you wish to subscribe, you write to Mr. P. J. Jackson, Advertising Contractor, 15, and 17, Grainger Street, Newcastle-on-Tyne; the money to be paid when the books are ready. As I have not seen any of the above-mentioned books, I am unable to give an opinion about them. But it's a poor book indeed that one cannot gather a wrinkle from. I am only acquainted with two journals which are published in this country appertaining to coach building, although there are several in America. *The Coach Builder's and Harness Maker's and Saddler's Art Journal* is a monthly journal; the annual subscription is 25s. post free. Artisans' subscription for the same is 20s. per annum post free. This *Coach Builder's Art Journal* is published by J. & C. Cooper, 64, Long Acre, London. The other journal is *The Saddler's, Harness Maker's, and Carriage Builder's Gazette*, also published monthly, at a yearly subscription of 4s., and can be bought of the publishers, Mr. John Kemp & Co., 46, Cannon Street, London, and at 75, Piccadilly, Manchester.—W.

Patenting Medical Receipts.—A. A. (*Liverpool*).—To do this the same steps must be taken and the same fees paid as in patenting an invention of any other kind (see "Taking Out a Patent," Vol. I., page 545). But many of the "patent medicines," so called, have never been made the subjects of patents: they are merely vended under the protection of the Government stamp. The use of this "Appropriated Medicine Stamp" has not the fully protective effect of letters patent, but being supplied only to the persons at whose cost it has been prepared, or to his accredited agent, it affords a considerable amount of protection. For information respecting the supply of such stamps, application should be made to the Secretary, Stamps and Taxes, Inland Revenue, Somerset House, W.C.—C. C. C.

Rain Gauge.—F. W. T. (*Ipswich*).—The accompanying sketch shows a vertical section of a rain gauge. Upon a heavy base A A, a cylindrical vessel B is mounted; to its side is fitted a glass tube C, to show the height of water in the collecting vessel B. D is a funnel or tin dish of exactly the same internal diameter as B, into the top of which it fits as shown. The vessel B should be coated with non-conducting material to prevent the contained water from being evaporated by external heat, and the hole E in the funnel should be no larger than necessary. The top of the tube C is connected with the body B, so that any vapour



Rain Gauge.

formed in the tube may return and be condensed instead of passing away; and if a dry wind were blowing across the top of an open tube an appreciable quantity of moisture would be lost. Although a rain gauge is a simple instrument, it must be used with judgment for its readings to be of any scientific use. It should not be less than 10 in. diameter, and may be 14 in. to 18 in. high. It must be put in some open place, and not far above the ground, for the raindrops increase in size as they fall; this is due to the fact that they come from a colder upper region, and in their descent continue to condense moisture from the warmer air through which they pass.—F. C.

Book on Smiths' Work.—W. S. C. (*North Shields*).—The only books published on art wrought iron work are expensive ones. There is "Metal Work, and its Artistic Design," by Digby Wyatt, published at about six guineas, second-hand about £2. "Decorative Wrought Iron Work of the Seventeenth and Eighteenth Centuries," by D. J. Ebbetts, published by Batsford, High Holborn, 10s. 6d. "Examples of Ornamental Metal Work," by Henry Shaw, published by Pickering, 1836. I do not know the price, but you can get a second-hand copy for 15s. or £1. I fancy Ebbetts' book might suit your purpose best, but there is really no information worth mentioning as to methods of work to be obtained from any of this class of books. You could gather far more by taking a trip to the wrought iron gallery at South Kensington Museum, where there are a large number of examples of different ages and countries. And I do not know of any books on smiths' work that can be recommended; I believe there are only two or three in existence, and a smith would not think them worth looking at. If you have the first volume of Holtzapffel's "Turning and Mechanical Manipulation," you will find in that the best summary of *principles* ever written, and which I have seen reproduced, more or less, in perhaps half a dozen books and cyclopædias. If you want to learn smithing, take a few practical lessons from a local craftsman; and, as far as written descriptions can help, I will promise that you shall find more in WORK, when I get to the practical section, than you will find in any book or journal yet printed. You need not have got Low Moor iron for ornamental work; Lord Ward's best brands, at about half the price, which you can obtain of local ironmongers, would answer the purpose just as well. Do you mean that you cannot get iron light enough for the scroll work of light candelabras? You can get it as thin as ⅛ in. If you want it thinner, use hoop iron, and, if thinner still, get the thin strips used for bent iron work.—J. H.

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—J. (*Belfast*); CRESCENDO; H. J. A. (*West Hougham*); J. T. (*Seacombe*); A NEW SUBSCRIBER; A. F. (*Warrington*); S. P. (*Middlesbrough*); J. G. B. (*Walthamstow*); W. C. Y. C. (*Walthamstow*); P. Q.; G. T. (*Old Shildon*); A. W. P. (*Jersey*); W. E. R. (*Penryn*); M. (*London*); C. C. (*Milford*); CYCLIST: W. K. (*Easky*); C. B. (*Notting Hill*); N. B. (*Totnes*); J. B. (*Birkdale*); T. D. (*Oldham*); PURCHASER OF CYCLE; W. R. (*Oswestry*); R. W. D. (*Poplar*); P. J. (*Leytonstone*); EXPANSION; L. W. P. (*London, W.*); L. B. (*West Bromwich*); E. S. (*London, W.*); D. O. W. (*Ipswich*); W. W. (*Glasgow*); W. B. (*Stockport*); F. M. (*Ayrshire*); S. J. (*Stockport*); W. J. T. (*Gateshead-on-Tyne*); J. A. N. (*Portsmouth*); A. W. S. (*Enfield*); T. T. (*Silvertown*); A. H. S. (*Edinburgh*); ELIPH; INKERMAN; R. E. D. (*Gateshead*); WRIGHT (*Greenock*); D. M. & Co. (*Manchester*).

Trade Notes and Memoranda.

THE Committee of Council on Education have allocated for the financial year 1891-92 the sum of £5,000 for grants in aid of technical instruction given under the Technical Instruction Act. In a discussion on the subject in the House of Commons, Mr. Mundella remarked that there was not a canton in Switzerland that would not be ashamed of such a paltry provision for technical education. Mr. Goschen, however, explained that the smallness of the amount was the result of the comparatively small demand made by the local authorities, and that there was every disposition on the part of the Government to meet the full requirements of the Act. The grants in aid will not necessarily be equal to, and in no case will exceed, the amount contributed by the local authority out of the rates, and each grant will be computed, as far as possible, on the basis of the amount spent on subjects of technical instruction other than those for which the Science and Art Department gives aid.

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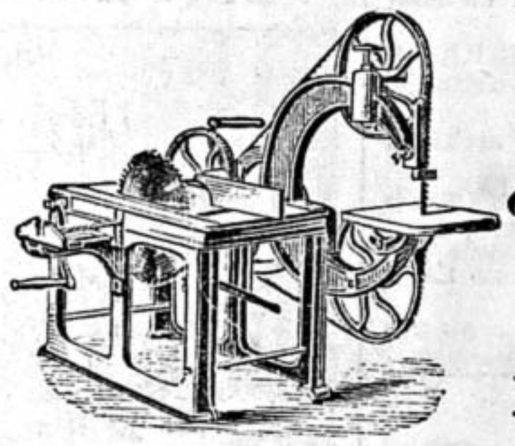

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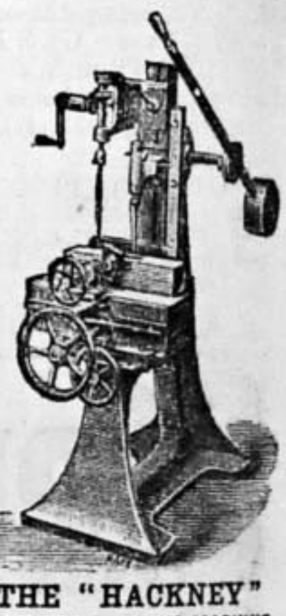

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